Report on the 2016 KwaZulu-Natal Pearson eLearning Pilot Project

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Abstract

Governments and institutions in Africa are increasingly turning to ICT-based solutions in order to improve the education performance of their students. Specifically, the promise of eLearning to improve and to better facilitate learning has spurred innovation towards provision of eLearning resources on mobile devices such as tablets. Tablets hold enormous potential in delivery of eLearning due to their portability and provision for multiple uses. This study aimed at understanding the efficacy of tablet-based digital content on teachers and learners and consequently, to offer recommendations for sustainable, scalable eLearning models. This report presents key findings from an eLearning research pilot conducted in 12 schools at KwaZulu-Natal province in South Africa. The results indicate that an eLearning intervention could have an impact on the learners' subject-specific skills, that teachers and learners gained digital literacy in their use of the eLearning intervention, that learners gained confidence in using the eLearning intervention and integrated various digital resources in their learning over time, that learners were sharing content more over time, that the majority of the teachers felt comfortable integrating the digital content in their teaching over time. The findings in this report would help educational leaders, content developers, technological providers and the Department of Education to make sound decisions in relation to developing and implementing eLearning interventions, especially in South African schools. Based on the findings of the eLearning research pilot, this report also presents recommendations based on pedagogy, eLearning, training, support and facilitation, implementation, hardware, partnerships and provides possible considerations for tablets in educational rollouts.

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Keywords: Baseline assessment, Digital content, eLearning, eReader, ICT-based solutions, ICT knowledge, ICT capacity, Information and Communication Technologies (ICT), computers, interactive boards, Internet, laptops, mobile devices, mobile learning projects, mobile phones, project assessment, qualitative data, quantitative data, tablets, Wi-Fi routers.

Introduction

This article reports key results and conclusions about a more comprehensive pilot project related to the feasibility of introducing eLearning in KwaZulu-Natal public schools, conducted with the financial support of Pearson Education South Africa. This is an abbreviated report that publishes selected highlights of the more comprehensive in-house report written by Klopper, Mbogo and Rosen (2016). The empirical research for both projects utilised a problem solving approach to identifying problems around eLearning in KwaZulu-Natal public schools.

eLearning has been defined as learning supported or enhanced through the application of Information and Communication Technologies (ICT) (Ssekakubo, Suleman & Marsden 2011). In Africa, eLearning has grown in leaps and bounds over the past several years. The affordances of new and powerful communications technologies and their ability to create and sustain communities of learners have established eLearning in the mainstream of education (Garrison 2003). This is evident from the increasing number of eLearning conferences that are based in Africa alone, such as eLearning Africa and the eLearning Innovations Conference, and the growing number of eLearning initiatives, projects, organizations and partnerships. Further, it is claimed that in Africa's schools, old-fashioned, dusty textbooks are gradually being replaced by tablets, computers and mobile phones (Robson 2014). In addition, an emerging body of evidence strongly suggests that effective eLearning can produce promising effects. Research also seems to indicate that a more technology-rich environment delivers greater impacts (Intel 2012). Thus, education systems are looking to eLearning programs to address learning challenges and to substantially improve quality and content of their education (Olson *et al.* 2011).

Governments and institutions in Africa are increasingly turning to ICT-based solutions in order to improve the education performance of their

students. For example, one of the strategies that the South African Department of Education (DoE) put in place to contribute towards improving performance among students is the integration of ICT in teaching (Matshediso 2015). Further, in its 2015 five-year strategic plan, the South African Department of Basic Education (DoBE) emphasized that the integration of ICT in teaching and learning will form a part of the core strategies for developing learners and teachers who have relevant skills that match the modern needs of the changing world (DoBE 2015). Indeed, the DoBE strategic report acknowledges that access to ICT resources is no longer a nice-to-have but an urgent requirement for advancing teaching and learning (DoBE 2015).

The current research on the feasibility of introducing eLearning in KwaZulu-Natal public schools forms part of long-term research on this topic, for instance the masters and doctoral level empirical projects that were conducted under the supervision of the lead author of the current article, Klopper. See Mhlane (2007), Nkabinde (2007), Matsemela (2007), Mazibuko (2007), Majozi (2008) and Woldu (2009).

The necessity of fostering 21st century skills cannot be underplayed. Problem solving has been highlighted as one of the key 21st century key skills (Mosharraf and Rosen 2014). Problem solving was identified as the top skill that is currently needed in the workplace (*The Economist* Intelligence Unit 2014). One of the ways that problems solving skills can be fostered in learners is by training learners in digital literacy and supporting their learning using technology. In fact, studies conducted by UNISA (Bester & Brand 2013) emphasize that learners would retain more information with the help of sufficient stimulating technological content in their learning materials. Further, the study showed that in technology-rich learning environments, learners can explore new information, construct new knowledge and link theories into practice, thus maximizing their achievement.

Clearly, the promise of eLearning to improve and to better facilitate learning has spurred innovation towards provision of eLearning resources. However, most learners who are in resource-constrained environments, such as in parts of South Africa, still have limited access to computers while outside the schools. In fact, statistics compiled by Stats SA show that only 21.4% of households in SA have a computer at home and, out of that percentage, only 10.1% have an Internet connection (Matshiana 2015). Within the institutions themselves, some schools have a limited number of desktop computers than could be shared among learners. Even in a relatively well-resourced

developing country like South Africa, it is not uncommon for a school of 1,000 learners to have only one computer room with 30 PCs (Traxler & Vosloo 2014). Thus, learners still need resources that support their learning and that they could use anywhere, anytime.

Mobile Devices

The availability and flexibility of mobile devices provides an opportunity to use them as a resource to support learning. This is especially because, in developing countries, mobile devices hold enormous promise as the single ICT most likely to deliver education, and to do so in a sustainable, equitable and scalable basis (Traxler 2011). Importantly, using mobile devices to enhance the learning process as well as the learning outcome is one of the common recommendations to approach the Education For All (EFA 2015) and Millennium Development Goals. To this end, a majority of Africa's mobile learning projects focus on formal education in primary and secondary schools, with a high concentration of projects in South Africa, Kenya and Uganda (Isaacs 2012). Most of these project use mobile phones to support the improved delivery of teaching and learning within classrooms, or to promote improved learner performance in ways that consider both formal classroom settings and informal learning environments (Isaacs 2012). For example, the X-kit Achieve! Mobile application[1] was launched in South Africa in October 2014. X-kit Achieve! Mobile is an application that recognises the need for revision and practice anywhere at any time. The application covers all cognitive levels and aids learners in mastering content and application thereof. The application was piloted with Grade 8 learners at a public secondary school in Johannesburg. Results from the pilot study show that there has been significant improvement in the performance of learners in Mathematics from the time they started using the application.

Evidently, mobile devices offer the promise of a sustainable solution to supporting learners. Mobile devices include laptops, tablets and mobile phones. Tablets have recently been introduced in schools through government and private partnerships and they hold enormous potential in delivery of eLearning due to their portability and provision for multiple uses. In fact, a project conducted by Pearson in 2014 indicated that single purpose devices are

[1] http://www.x-kit.co.za/

low priority for the market with more teachers and learners claiming to intend to purchase devices with multiple uses. 17% of teachers and 20% of school learners claimed that they were planning on buying tablets in the next two years, compared to 8% of learners and 13% of teachers who claimed they would be investing in an eReader in the next two years.

Problem Statement

It is presently unknown what the efficacy of the integration of tablet-based digital content in Natural Science, Mathematics and English FAL would be to primary and secondary school teachers and learners in public schools in KwaZulu-Natal.

Research Questions

To address the research problem, two research questions were posed:

1. *What is the efficacy of the tablet-based digital content on learners and teachers in Mathematics, Natural Sciences and English?*
2. *What are the recommendations for sustainable, scalable eLearning models for high quintile and low quintile schools?*

Research Approach

The study aimed at understanding the efficacy of the tablet-based digital content on teachers and learners and consequently, to offer recommendations for sustainable, scalable eLearning models. Therefore, the first step was the identification of 12 schools in KZN to participate in the study. Before the start of the eLearning research pilot, all the participating schools entered into a Memorandum of Understanding with the Project. Of the 12 schools that participated in the study, two are quintile 5 schools, seven are quintile 4 schools, and three are quintile 3 schools. All South African public schools are categorized into five groups, called quintiles, largely for purposes of the allocation of financial resources; schools in quintile 1, 2 and 3 have been declared no-fee schools, while schools in quintiles 4 and 5 are fee-paying schools (Casey 2013). For the purpose of this study, the two schools in quintile

5 were categorized as upper quintile schools, while the ten schools in quintiles 3 and 4 were categorized as lower quintile schools. Of the 12 schools, 6 are primary schools while 6 are high schools. The learners who participated in the study were in Grade 7 and Grade 8.

The schools were outfitted with interactive boards and teachers were supplied with laptops. Teachers were trained on the usage of the interactive boards and laptops. One class was selected per school to participate in the study. The teachers and learners of these classes were issued with tablets containing digital content on Mathematics, Natural Science and English FAL. The eLearning content was provided in the form of eBooks, interactive games and videos. Additional equipment such as Wi-Fi routers were also issued. At the beginning of the study, the teachers were trained on the use of the tablets and digital content in order to make them aware of the new content and also to address and demonstrate ways to use the tablet and content in the classroom. The tablets with digital content were used in the schools from February 2015 for a full school year.

The research was conducted in two ways: (i) using baseline assessment; and (ii) project assessment.

Baseline assessment was conducted first in order to understand the pre-project ICT knowledge and capacity of the schools, teachers and learners, and also in order to make comparisons after the tablets have been used. The baseline and project assessments were conducted using focus groups, surveys, classroom observations, test and improve assessments, and analysis of examination results. The baseline assessment was conducted in three ways: (a) overall pre-project status; (b) pre-project status among teachers; and (c) pre-project status among learners.

a. The overall pre-project assessment was measured along three metrics: the status of the digital infrastructure of the school; overall classroom challenges and subject specific challenges; and classroom beliefs and behaviours.

b. Among the teachers, pre-project assessment was measured along four metrics: home technology access; digital literacy level; previous level of technology initiative; and previous technology skills development.

c. Among the learners, pre-project assessment was measured along six metrics: home technology access; digital literacy level; day-to-day

learning tools; prior technology usage in class; peer assistance with technology; and prior digital awareness. The test and improve baseline assessment was conducted among learners and was measured along three metrics: learners per performance category; performance per summary skill; and performance by sub skill per class.

d. The project assessment was conducted in two phases: assessment of the initial use of the digital content among teachers; and follow-up assessments of the use of the digital content among teachers and learners. The project assessment was conducted in order to address the two research questions.

e. To address the first research question, qualitative data was collected during the initial use of the digital content by teachers in order to analyse: the implementation challenges; usage experience across the three subjects; and how the digital content was used across the three subjects. Further, quantitative data was collected in order to analyse the frequency of use of the digital content across the three subjects.

f. To address the first research question, qualitative data was collected during the follow-up digital content use by teachers in order to analyse: confidence with the digital content; current level of technology initiative; current technology skills development; teacher user experience across the three subjects; barriers to use of the digital content; how the digital content was used across the three subjects; impact of the digital content on the teaching style; how teachers collaborated and shared content; and teachers' perception on the use of the tablets and digital content. Further, quantitative data was collected in order to analyse the frequency of use of the digital content across the three subjects.

g. To address the first research question, qualitative data was collected during the follow-up digital content use by learners in order to analyse: what learners liked and disliked about the tablets and the digital content; which eLearning programs were used across the three subjects; how the eLearning programs were used; and use of the digital content in class. Further, quantitative data was collected in order to

analyse: learners' perception on the use of the tablets and the digital content; test and improve follow-up assessment; and examination results among learners who used the tablets and learners who did not.

In summary, the findings from the qualitative and quantitative data were analysed in order to answer the two general research questions:

1. *What is the efficacy of the tablet-based digital content on learners and teachers in Mathematics, Natural Sciences and English?*

In order to address this research question, four sub questions were posed:

i. ***How did the teachers and learners experience the implementation of the tablet-based digital content?***

To address this research question, an analysis was conducted to understand: the implementation challenges; teacher and learner usage experience across the three subjects; barriers to use of the digital content; and what learners liked and disliked about the tablets and the digital content.

ii. ***How did learners and teachers' access and use the digital content?***

To address this research question, an analysis was conducted to understand: how the digital content was used across the three subjects; the frequency of use of the digital content across the three subjects; which eLearning programs were used across the three subjects; how the eLearning programs were used; and the use of the digital content in class.

iii. ***What was the effectiveness of the digital content in assisting the teacher to deliver the curriculum timeously?***

To address this research question, an analysis was conducted to understand: confidence with the digital content; current level of technology initiative; current technology skills development; impact of the tool on the teaching style; how teachers collaborated and shared content; teachers' perception on the use of the digital content; and learners' perception on the use of the tablets and the digital content.

iv. ***What was the standard of learner achievement and competency in terms of subject-specific skills and ICT skills?***

To address this research question, an analysis was conducted to understand: test and improve follow-up assessment; and a comparison of examination results between learners who used the tablets and learners who did not.

2. What are the recommendations for sustainable, scalable eLearning models for high quintile and low quintile schools?

Analysis of the results that addressed the first research questions led to recommendations based on pedagogy, eLearning, training, support and facilitation, implementation, hardware, infrastructure, and suppliers, which addressed the second research question.

Research Design and Evaluation

In this section, the research design used in the eLearning research pilot is discussed by first describing the study participants. Thereafter, the data collection methods are described, followed by a discussion on the criteria used to address the research questions in the baseline assessment and the project assessment. The results from the study are presented in section 3.

Study Participants

Participants in the study were learners in Grade 7 and Grade 8 from 6 primary schools and 6 high schools, respectively, and teachers from these 12 schools. The 6 primary schools were: Isidingo Primary; Isikhwelo Primary; Ndongeni Primary; Sekalani Primary; Glenwood Preparatory; and Cwebeleza Senior Primary. The 6 high schools were: Zwelibanzi Secondary; Mqhawe Secondary; Nkosibumvu Secondary; Velabahleke Secondary; Durban Girls High; and Menzi Secondary. The schools were categorized according to quintiles. For the purpose of this study, the two schools in quintile 5 were categorized as upper quintile schools, while the ten schools in quintiles 3 and 4 were categorized as lower quintile schools. Table 1 shows the 12 schools that participated in the eLearning research pilot from February to October 2015.

Table 1: Twelve schools that participated in the eLearning pilot project

School	Quintile
Isidingo Primary	4 (lower quintile)
Isikhwelo Primary	4 (lower quintile)
Ndongeni Primary	4 (lower quintile)
Sekalani Primary	4 (lower quintile)
Glenwood Preparatory	5 (upper quintile)
Cwebeleza Senior Primary	4 (lower quintile)
Zwelibanzi Secondary	4 (lower quintile)
Mqhawe Secondary	3 (lower quintile)
Nkosibumvu Secondary	3 (lower quintile)
Velabahleke Secondary	3 (lower quintile)
Durban Girls High	5 (upper quintile)
Menzi Secondary	4 (lower quintile)

Data Collection Methods

Test-And-Improve Diagnostic Assessment

Test and improve is a Pearson diagnostic assessment tool used to identify subject-specific skill gaps. It was used as a tracking measure during the study in the three subject areas in order to understand the impact the eLearning solution had on learner performance. The test and improve baseline assessment was administered in March to learners in the classes that received the eLearning solution and to some learners in the classes that did not receive the eLearning solution.

The test-and-improve follow-up assessment was administered in October to a sample of learners in the classes that received the eLearning solution and to a sample of learners in the classes that did not receive the eLearning solution. The results of the test and improve assessments were shared with the relevant teachers. The aim of this was to empower the teachers with the knowledge of the gaps that exist in the subject and also to inform the teacher of the progress being made by learners using the eLearning solution.

Focus Groups

Focus groups were conducted with both teachers and learners in order to assess: teachers' and learners' experience with the tablet and the digital content; and teachers' and learners' confidence and subject skill. Each focus group was conducted by a Pearson and Maths Science Africa representative and lasted between one and one and half hours. Table 2 and Table 3 show the number of teachers and learners, respectively, who participated in the focus groups and completed the surveys from March to October 2015.

Table 0: Number of teachers who participated in the focus groups and completed surveys

Period	**Total number of teachers in focus groups**	**Total number of teachers who completed survey**	**Participating Schools**
March 2015	14	14	All 12 schools
July 2015	14	14	All 12 schools
October 2015	8	16	All 12 schools

Table 2: Number of learners who participated in the focus groups and completed surveys

Period	Total number of learners in focus groups	Total number of learners that completed survey	Participating Schools. (*n* = the number of learners that completed the survey per school)
May 2015	32 (2 groups of 8 Grade 8 learners and 2 groups of 8 Grade 7 learners)	524 (252 in Grade 8 and 272 in Grade 7)	Glenwood Primary (n = 31) Cwebeleza SP (n = 31) Isidingo Primary (n = 62) Sekalani Primary (n = 37) Isikhwelo Primary (n = 53) Ndongeni Primary (n = 58) Durban Girls High (n = 26) Mqhawe Secondary (n = 20) Menzi Secondary (n = 53) Nkosibumvu Secondary (n =42) Velabahleke High (n = 53) Zwelibanzi Secondary (n = 58)

September 2015	32 (2 groups of 8 Grade 8 learners and 2 groups of 8 Grade 7 learners)	273 (161 in Grade 8 and 112 in Grade 7)	Glenwood Preparatory (n = 39) Cwebezela SP School (n = 20) Sekalani SP School (n = 53) Mqhawe High School (n = 29) Nkosibomvu Secondary (n = 25) Velabahleke High School (n = 18) Zwelibanzi High School (n = 62) Durban Girls High School (n = 27)

Paper-based Surveys

The learner survey contained three parts: demographic information that asked about the school, gender, and age; self-rated digital literacy and ownership of electronic devices; and feedback on the use of the digital content. The teacher survey contained three parts: name of school and teaching subject; use of electronic devices in the classroom; use of the digital content; and feedback on the use of the digital content. Table 2.2 and Table 2.3 show the number of teachers and learners, respectively, who completed the surveys from March to October 2015.

Classroom Observations

The lead author did classroom observations as part of teams of Pearson and Maths Science Africa representatives during class sessions. The aim of the classroom observations was to add context to the teacher and learner findings from focus groups and surveys.

Examination

June examination results from a sample of project schools were analysed to compare the performance between the tablet and non-tablet classes.

Equipment and Support

Materials Used

The learners and teachers were issued with Android tablets (Lenovo Idea Tab A7600). The eLearning content was provided in the form of core eTextbooks (Platinum Range); curated digital assets (including games, videos, listening texts and self-marking revision activities); and practice and revision resources (selected X-Kit Achieve! study guides in eBook format, Access to X-Kit Achieve! Mobile quizzes for Mathematics, Natural Science and English for Grade 8, and Smart Kids Interactive Mathematics Grade 7 workbook). In addition, the learners were also issued with headphones, printed lessons plans, access to Longman-HAT Language portal, and eReaders on Platinum English FAL for Grade 7 and Grade 8. Wi-Fi Routers were provided to the schools in partnership with Vodacom.

Each school also received a hardcopy set of the Platinum Learners Books for Natural Science, English and Mathematics together with access to Bounce pages that provide for learning beyond the classroom by providing access to select video content.

Security Provided to Schools

Figure 2.2 shows some of the security features provided in the schools to support the eLearning research pilot. Charging trolleys stored in a school's strong room and burglar bars were installed. This project took the security of learners and staff into account before deploying the devices to schools. Thus, it was agreed with schools that tablets would not be taken home but rather left on the school premises. Pearson and Maths Science Africa worked with schools in upgrading security and identifying secure areas for storing hardware. Of the 655 devices deployed to schools 2 devices have been stolen and 1 device was reported broken over the period January 2015 to October 2015. Hence, only 0.5% of the issued devices went missing or stolen. This shows that the security measures that were put in place to secure the devices and equipment were successful.

Additional Support Provided To Schools

Teachers had support from Pearson Customer services with regards to any queries relating to the tools and services provided throughout the project.

Baseline Assessment

The baseline assessment was conducted in March 2015 in four ways: (i) test and improve baseline assessment among learners; (ii) overall pre-project status; (iii) pre-project status among teachers; and (iv) pre-project status among learners.

Test and Improve Baseline Assessment among Learners

The test and improve baseline assessment was conducted among learners and was measured along three metrics: learners per performance category; performance per summary skill; and performance by sub skill per class.

The summary skills are skills that consist of a number of sub-skills. The sub-skills are the smaller building blocks of the summary skills. The summary skills and the sub-skills are ranked according to performance, from the skill with the lowest score to the skill with the highest score. This is to enable teachers to target the skills with the lowest scores for intervenetion.

Overall Pre-Project Status

The overall pre-project assessment was measured along three metrics: the status of the digital infrastructure of the school; overall classroom challenges and subject specific challenges; and classroom beliefs and behaviours. The status of the digital infrastructure of the school was evaluated through school visits and classroom observations to examine the availability and use of ICT tools.

The overall classroom challenges were evaluated in terms of lack of know-how, restrictions of use, exclusivity attached to the intervention, lack of infrastructure, and technology governance. In addition, subject specific challenges were evaluated in terms of class size, ability to keep up with the curriculum, meeting learners at their level, keeping up with technology, keeping learners engaged, and use of language.

Classroom beliefs and behaviours across the three subjects were evaluated to understand the practice in terms of working together to solve a problem, sharing knowledge, how homework is conducted, and how projects are conducted.

Pre-Project Status among Teachers and Learners

Among the teachers, pre-project assessment was measured along four metrics: home technology access; digital literacy level; previous level of technology initiative; and previous technology skills development. Among the learners, pre-intervention assessment was measured along six metrics: home technology access; digital literacy level; day-to-day learning tools; prior technology usage in class; peer assistance with technology; and prior digital awareness.

A survey of home technology access among teachers and learners examined how and which technology teachers and learners had access to outside the classroom. Digital literacy level was measured among teachers and learners and examined the level of literacy from most comfortable to least comfortable. Previous level of technology initiative among teachers evaluated how teachers created awareness of technology to their learners, and the frequency of raising awareness regarding rules that govern digital use. Previous technology skills development among teachers evaluated if teacher have had formal or informal training on ICT. Evaluation of day-to-day learning tools among learners evaluated what ICT tools learners normally use. Evaluation was also conducted to examine learners' prior technology usage in class. Further, evaluation was conducted to examine the level of peer assistance with technology among learners, and their prior digital awareness.

Project Assessment

The project assessment was conducted periodically between March and October 2015 in two phases: assessment of the initial use of the digital content among teachers in March; and follow-up assessments of the use of the digital content among teachers and learners between May and October.

Initial Assessment of Teachers

The initial digital content use by teachers was measured along four metrics: the implementation challenges; usage experience across the three subjects; how

the digital content was used across the three subjects; and the frequency of use of the digital content across the three subjects.

The implementation challenges examined the initial experience with the tablets and digital content from least challenging to most challenging. The usage experience was evaluated by teachers rating their user experience based on various statements, such as ease of navigation on the eBooks, ranging from strongly disagree and strongly agree. Evaluation of how the digital content was used across the three subjects was measured based on four types of use: introducing a new concept; motivating and engaging learners; consolidating a concept; and revision and practice. The frequency of use of the digital content across the three subjects was measured by examining the frequency of use of the various eLearning programs installed in the tablet.

Follow-Up Assessments of Learners and Teachers

The follow-up digital content use by learners was measured along four metrics: what learners liked and disliked about the tablets and digital content; use of eBooks, interactive games and videos across the three subjects; learners' perception on the use of the tablets and digital content; the use of the tablets and digital content in class; and examination results.

The follow-up digital content use by teachers was measured along ten metrics: confidence of teachers with the digital content; current level of technology initiative among teachers; current technology skills development; teacher user experience across the three subjects on scale of strongly agree to strongly disagree; barriers to usage; frequency of use across the three subjects; how the digital content was used across the three subjects; impact of the digital content on the teaching style; how teachers collaborated and shared content; and teachers' perception on the use of the tablet and digital content. To analyse the impact of the digital content on the teaching style, there was an assessment of ICT integration to the teaching style of teachers.

Baseline Results

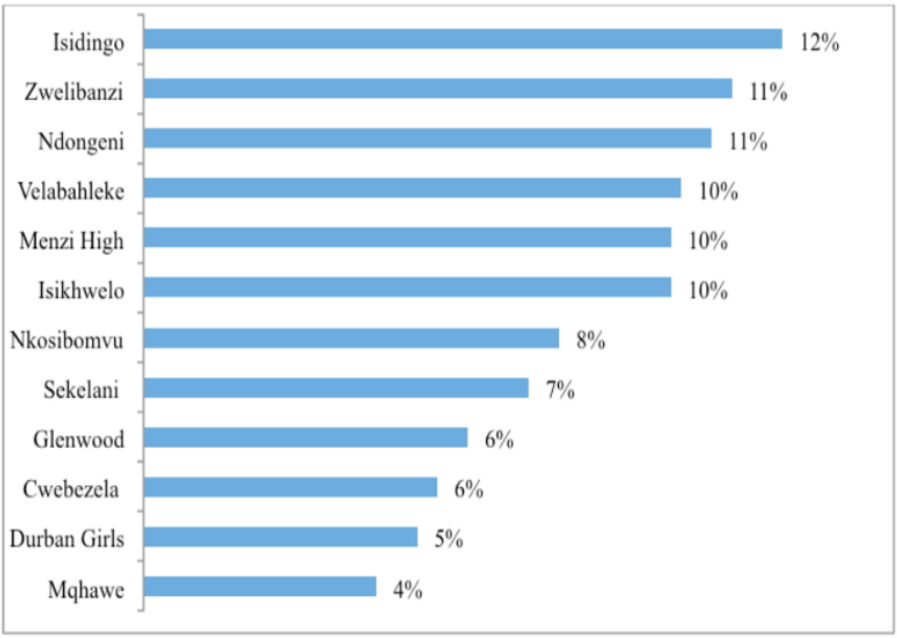
Learners' Demographics

Learners participated in the study in May, September and October 2015. The information on demographics was obtained from surveys that the learners completed.

May Study

A total of 524 learners from the 12 schools participated in the May Study. Figure 1 shows the percentage of learners from the 12 schools that completed the survey. Figure 2, Figure 3, and Figure 4 show the distribution of the learners based on gender, grade and age, respectively.

Figure 1: Percentage of learners per school who completed the survey in May study



In the May phase of the project 59% of the learners were girls and 40% were boys; 48% were in grade 7 and 52% were in grade 8; 2% were 11 years old, 27% were 12 years old, 47% were 13 years old, 2% were 14 years old, 4% were 15 years old and none were 16 years or older.

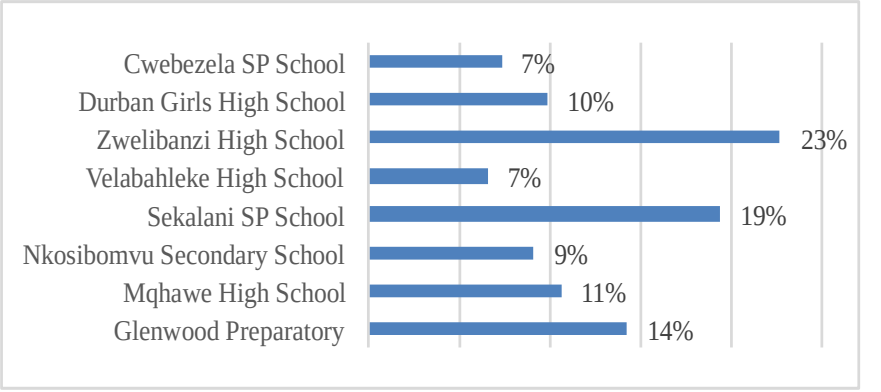
Isidingo Primary had the most number of learners who completed the survey. The split across grades was relatively equal, with a skew towards girls. In line with South African school going age, the majority of the sample was 12 or 13 years old. However, 11 of the learners were 11 years old, all in Grade 7,

which may indicate that they went to school early and were yet to turn 12 years old this year. There was one 16-year-old learner but due to small sample the percentage is not visible in Figure 3.4.

September Study

A total of 273 learners from the 12 schools participated in the September Study. Figure 3.5 shows the percentage of learners from the 12 schools who completed the survey. Figure 3.6 and Figure 3.7 show the distribution of the learners based on gender and age, respectively. Zwelibanzi High School had the most learners who completed the survey. There was a skew towards girls. In line with South African school going age, the majority of the sample was 13 years old.

Figure 2: Percentage of learners per school who completed the survey in September study



In the September phase of the project 61% of the learners were girls and 39% were boys; 48% were in grade 7 and 52% were in grade 8; 2% were 11 years old, 27% were 12 years old, 47% were 13 years old, 2% were 14 years old, 4% were 15 years old and none were 16 years or older.

Baseline Assessment Results

Test and Improve Baseline Assessment among Learners

All the 12 schools participated in the test and improve baseline assessment in Mathematics, English and Natural Science for Grades 7 and 8. Figure 3 shows the school percentage average per subject for Grade 7 and also the overall school average. Figure 4 shows the school percentage average per subject for Grade 8 and also the overall school average. The overall school averages for Grade 7 were almost the same across the lower quintile schools. On the other hand the upper quintile school (Glenwood Prep) showed a significantly better performance in the subject averages and also the school average than the lower quintile schools. Similarly, the overall school averages for Grade 8 were almost the same across the lower quintile schools, especially in three of the schools. Two of the lower quintile schools recorded a higher overall school average due to a better average in English. On the other hand, the upper quintile school (Durban Girls High School) showed a significantly better performance in the subject averages and also the school average than the lower quintile schools.

Figure 0: Grade 7 school percentage average per subject and overall school average (Baseline Test and Assessment)

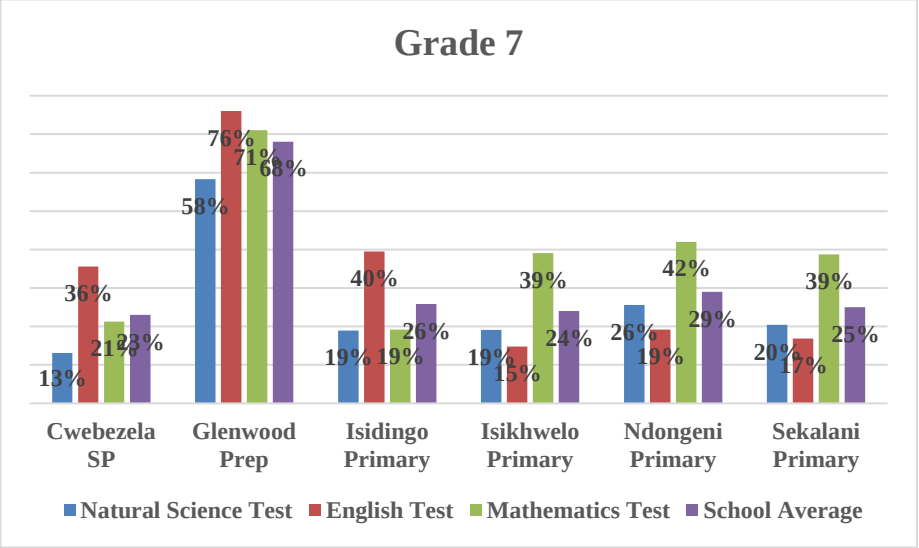
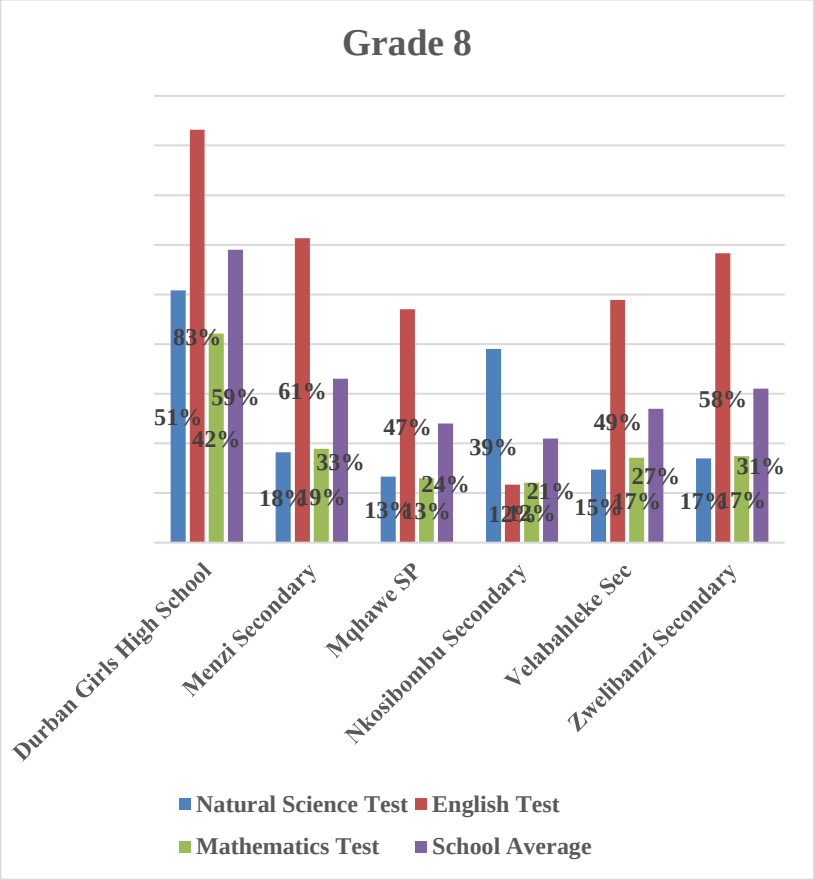


Figure 4: Grade 8 school percentage average per subject and overall school average (Baseline Test and Assessment)



The difference in performance between upper and lower quintile schools is further evidenced in the learner performance distribution per category. For example, Figure 5 shows a graphic view of the distribution of scores of a class in Grade 8 English test at Durban Girls High School. The number of learners in the class group is shown per performance category. By contrast Figure 6 shows a graphic view of the distribution of scores of a class in Grade 8 English test at Menzi Secondary.

Figure 5: Learner per performance category in English at Durban Girls' High School (Baseline Test)

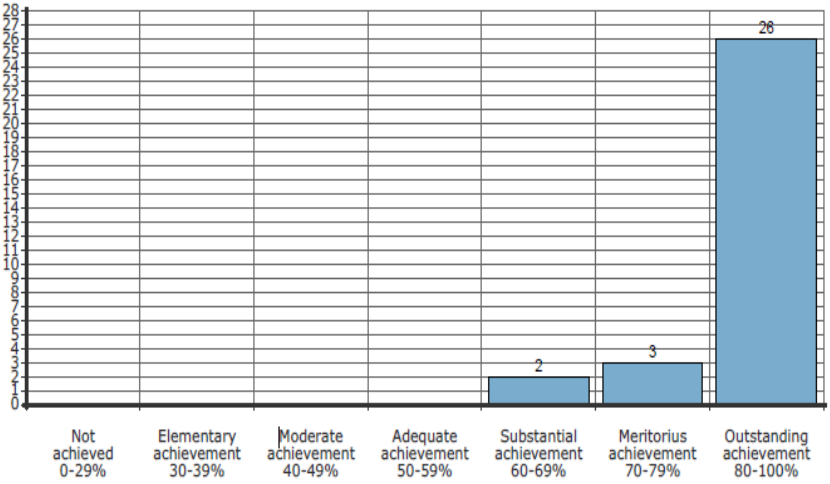
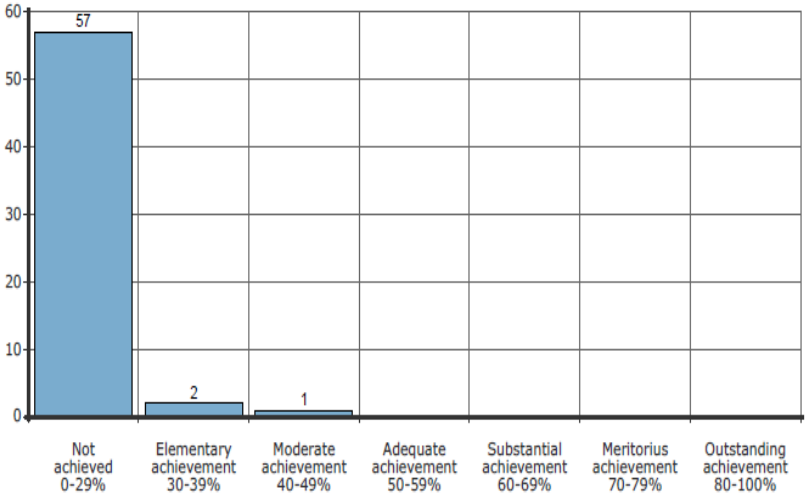


Figure 6: Learner per performance category in English at Menzi Secondary (Baseline Test Assessment)



The results show that learners at Durban Durban Girls High School had outstanding achievement in the subject, while learners at Menzi Secondary did not achieve above 29%. Learners' marks in these diagnostic tests are generally lower than what they usually obtain in School-Based Assessments (class tests and examinations) because: learners do not have time to prepare; class tests and mid-year exams are set on selected content; and learners might, at the time of the test, not be able to recall the content. Indicating that although they understood the concept at the time, it was never internalised. These reports are not intended to predict exam and test results, but rather to identify potential problem areas for learners as they progress towards Grade 12 and beyond.

Digital Infrastructure

Figure 3.12 shows the level of exposure and experience to digital infrastructure in the 12 schools. The 7 schools on the left of Figure 3.12 had low levels of exposure and experience with technology in the classroom, with the schools tagged red having the lowest levels of exposure to ICT tools. These schools show indications of lower comfort levels with digital tools, a lower ability to smoothly transition digital usage into execution of lessons, little presence of other digital tools in the classroom, low Internet access at school and little previous use of digital and a competency in the classroom. For example, Figure 3.13 shows an example of one of the schools with lowest availability and use of ICT tools. However, some of the schools in this category had some exposure to ICT tools. For example, Cwebezela Senior Primary had a teacher who was bringing a laptop and projector to school to optimize his lessons. On the other hand, Nkosobumvu Secondary and Ndongeni Primary both had smartboards in the classroom that could be used, but they were not being utilized.

The 3 schools in the middle of Figure 3.12 had mid-level exposure to technology in the classroom, or had at least one classroom where a full suite of technology was available and being used, for instance, one Computer room with a projector and smartboard. For example, some of the staff at Sekalani Primary demonstrated enthusiasm and initiative in using the computer room to optimize a lesson with the tablets. Figure 3.14 shows an example of one of the schools with mid-level availability and use of ICT tools.

The two schools on the right of Figure 3.12 demonstrated higher comfort levels with digital tools, higher ability to smoothly transition digital

usage into execution of lessons, presence of other digital tools in the classroom, Internet access at most areas of the school, and evidence of previous use of digital and competency in the classroom. Figure 3.15 shows an example of one of the schools with high-level availability and use of ICT tools.

In relation to the baseline test and improve assessment results reported in section 3.2.1, it is evident that the level of digital infrastructure previously provided by the school impacts the opportunity for optimal usage of the eLearning resource. Schools with better digital infrastructure and usage thereof displayed higher levels of integration of the eLearning resource.

Overall Classroom Challenges

Table 4 overleaf, shows the reported classroom challenges and their specific descriptions. The biggest cluster of challenges was the lack of basic skill in most schools, particularly those where technology in the classroom is a completely new concept. In classrooms where technology has been used before, this challenge was about the need for assistance to make use of the devices and content in a more integrated and personal way. In addition, keeping up with the technology was the topmost challenge across all the subjects. However, other challenges were cited as well for all subjects, such as: class size; keeping up with the curriculum; meeting learners at their level (levelling); keeping learners engaged; and language. Language was more of an issue in Natural Science and Mathematics.

Classroom Beliefs and Behaviours

Table 5, on page 341, shows the applicability of beliefs and behaviours applied in the three subjects. Working together is common across all subject areas, whereas encouraging the sharing of knowledge is less important in Mathematics. Mathematics teachers were also less likely to have homework and projects done in class, and would rather send it home, while English teachers encouraged projects to be completed at school.

Table 4: Reported Classroom Challenges and their Specific Descriptions

Lack of Know-how	Restriction of use	Exclusivity due to the intervention	Lack of infrastructure	Techno-logy Gover-nance
Lack of basic device familiarity and knowledge. Overwhelmed by navigation of the device. Overwhelmed by the amount of content. Struggling to integrate use of the device and the content with current technology and content. Confusion regarding where to go for technical and software assistance	Inability to take devices home restricts class preparation and impacts time management. Inability of learners to take devices home for homework – cannot make device and content 'their own' Low levels of familiarity with how to operate device	Non-intervention class curiosity. Teachers having difficulty justifying that only one class may participate in the pilot intervention	Internet connection not working. No projectors or screens.	Distraction of non-learning related content at learners' fingertips. Time taken to re-issue device at the start of every lesson wastes lesson time.

Table 5 Applicability of Beliefs and Behaviours across the three subjects

	Natural Science	Mathematics	English
Work together to solve problem			
Encouraged to share knowledge			
Homework is done in class			
Homework is done at home			
Projects are done at school			✓
Projects are done at home			

Digital Literacy Level

Teachers

The teachers were asked to rate their digital literacy from most comfortable to least comfortable. The majority of teachers claimed to sit in the middle and 'still learning'. For example, some teachers indicated that they had not been exposed to computers before but were still learning. Other teachers claimed to be very confident in use of ICT and indicated that they had had a good background at school.

Learners

Five hundred learners were asked to indicate their level of digital literacy. Figure 7 shows the percentage responses among all the learners. Figure 8 shows the distribution of learners on their digital literacy across Grade 7 and 8.

Almost 7 in 10 learners considered they should still be learning how to use computers and technology. Only slightly more Grade 8 learners felt more confident. Those who felt more confident attributed this to a combination of: having been previously exposed and used computers outside of school; helping

others work with technology; or enjoying exploring technology. Conversely, those who were least confident attributed this to the fact that they had little exposure or use of technology and found it difficult to understand its use.

Figure 7: Digital Literacy among learners

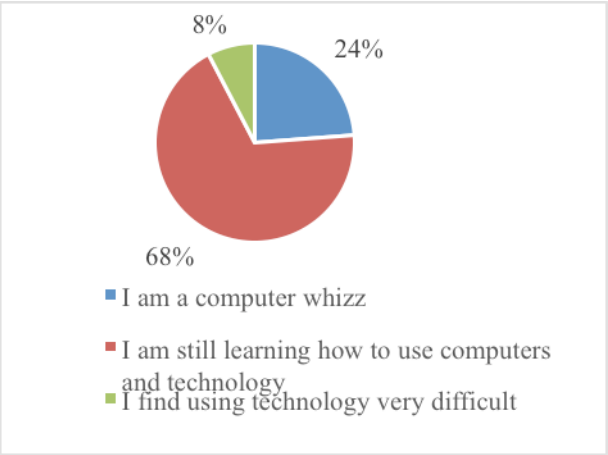
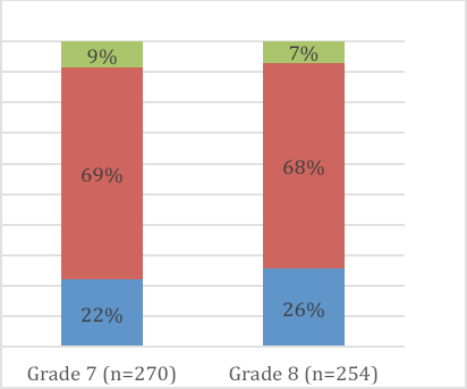


Figure 8: Digital Literacy per Grade



Initial Assessment Results

Implementation Challenges

Initial experience of the project was measured by rating the experience from most challenging to least challenging. The majority of teachers claimed that the implementation of the project went smoothly with a moderate number of challenges. For example, some teachers indicated that they did not know how to use some of the applications hence they took the time to familiarize themselves. There was an equal number of teachers who felt that the implementation went very smoothly as there were those who felt that it was very challenging. Those who felt that the implementation went very smoothly claimed a higher access to other devices at home and easier navigation of the device to access the content. Those who found it very challenging mentioned that they experienced operational difficulties with lack of familiarity of device usage among their learners.

Usage Experience across the Three Subjects

More Natural Science teachers really enjoyed using the tablets in class. Although they found the learner eBooks easy to find, most of them felt that it was not easy to integrate the eBook and digital resources. Similarly, English teachers indicated that they also really enjoyed using the devices in class and found that the learners were attentive. However, they were also struggling to integrate the eBook and digital resource content. Mathematics teachers claimed to find integrating the eBook and digital resources easier, and could find them easily, but struggled with navigation of the eBook. Most of them disagreed with the fact that learners were attentive when using the content on the device.

Frequency and Types of Use Across the Three Subjects

The frequency of use of the eLearning solution across the three subjects was measured by examining the frequency of use of: the tablet by teachers and learners; eBooks; digital resources; lesson plan; X-Kit Achieve Mobile application; educational website; and references in lesson plans. Table 3.4 shows a summary of the types of the frequency and type of use across the three subjects. Overall, teachers were only using eLearning resource that they were more familiar with, hence full optimization of the entire suite of content tools

was low. Many of the least used products required use of the Internet. Based on classroom observations, it was also clear that teachers, while using the provided resources, had little knowledge of how to use the applications available on the devices. Although learners were more adept at these, they had little knowledge of applications such as Excel and PowerPoint.

Table 7: Summary of the types of the frequency and type of use across the three subjects

	Natural Sciences	Maths	English
Most Frequent (combination of high frequency and most used)	Learner eBook, Videos	Lesson Plans & Videos	Learner eBooks, Videos, Auto-marking activities & Games
Most used for	Introducing new concepts	Motivating and Introducing new concepts	Motivating and Revision
Least used	X-Kit Achieve Mobile Educational Website references in Lesson Plans	X-Kit Achieve Mobile Auto-marking activities and Games	Educational Website references in Lesson Plans Longman-Hat language portal

Assessments with Learners and Teachers from May to September

Learners Research Results

School-based Assessment

For the purpose of illustration, June examination results for Mathematics, Natural Science and English from three schools are used. A comparison is made between a non-tablet class and a tablet class in an upper quintile school for Grade 7 (Glenwood Prep). Further, a comparison is made between a non-tablet class and a tablet class in a lower quintile school for Grade 7 (Cwebeleza Primary). Similarly, a comparison is made between a non-tablet class and a tablet class in an upper-quintile school for Grade 8 (Durban Girls High School). In addition, a comparison is made between June examination results and December examination results for Durban Girls High School and Isidingo Primary.

Glenwood Preparatory

Thirty-five learners at Glenwood Prep took the June examination in the tablet class and 35 learners in the non-tablet class. Figures 9, 10 and 11 show the number of learners in the various performance categories for Mathematics, Natural Science, and English, respectively. In all the three subjects, all the learners in the tablet classes scored 50% and above, in comparison to the learners in the non-tablet classes. Further, all learners in the tablet English class scored 70% and above, while several learners in the non-tablet class scored less than 70%. These results show evidence that the learners who used the eLearning research pilot benefitted from its use and consequently, could perform better in the subject than those who were not exposed to the eLearning research pilot.

Figure 9: Number of learners in the various performance categories for Mathematics. Marks in %

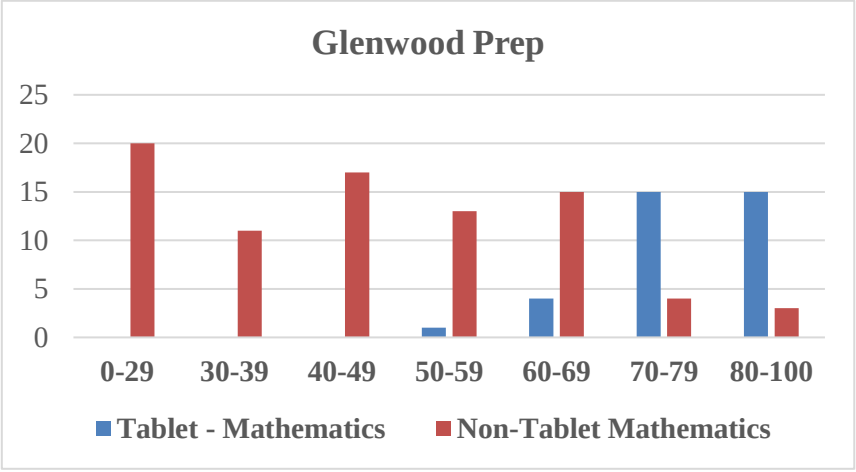


Figure 10: Number of learners in the various performance categories for Natural Science. Marks in %

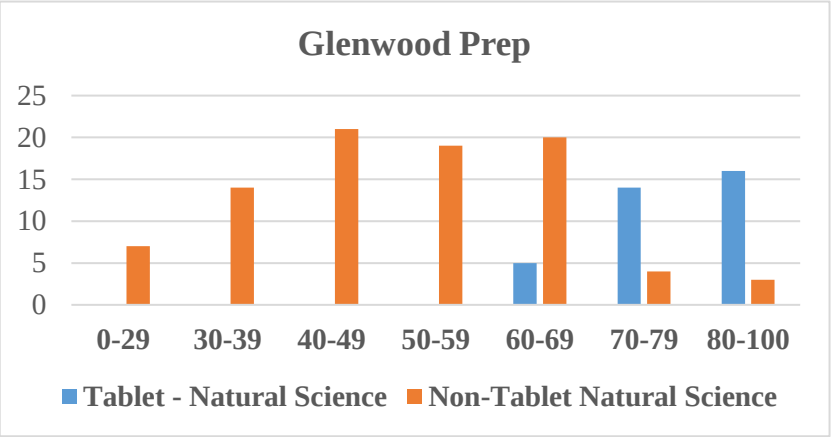
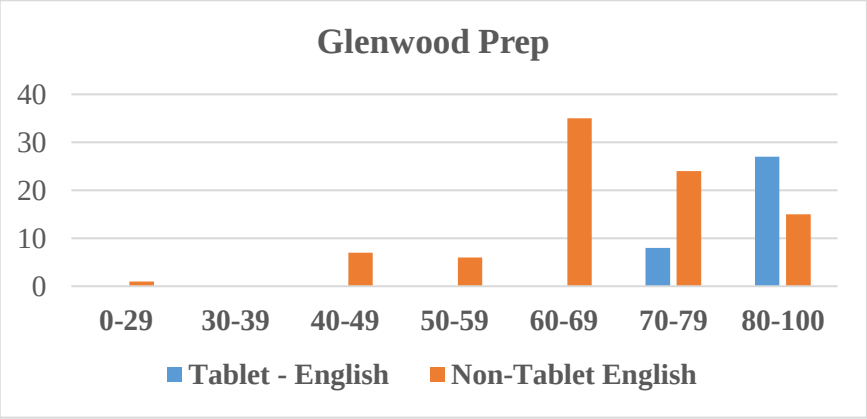


Figure 11: Number of learners in the various performance categories for English. Marks in %



Cwebeleza Primary

Thirty learners at Cwebeleza Primary took the June examination in the tablet class and 28 learners in the non-tablet class. Figures 4.4, 4.5and 4.6 show the number of learners in the various performance categories for Mathematics, Natural Science, and English, respectively. There were more tablet learners who scored 70% and above in Mathematics than non-tablet learners. There were more tablet learners who scored 40% and above in English than non-tablet learners. These results show evidence that the learners who used the eLearning research pilot benefitted from its use and consequently, could perform better in the subject than those who were not exposed to the eLearning research pilot.

Figure 12: Number of learners in the various performance categories for Mathematics. Marks in %

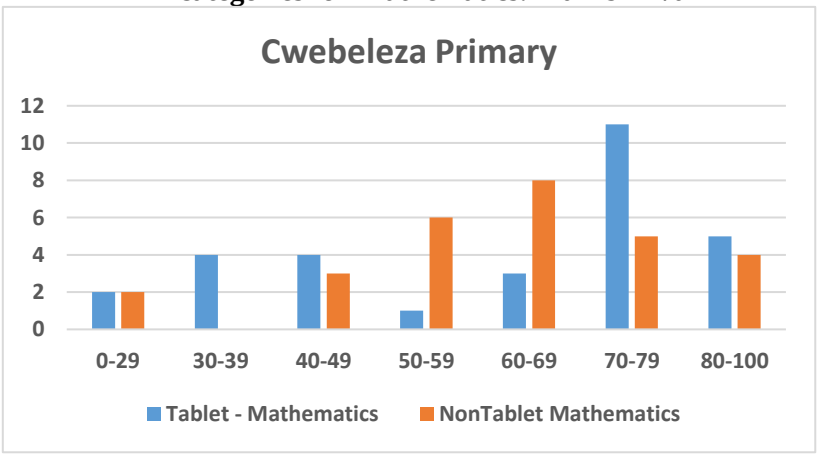


Figure 13: Number of learners in the various performance categories for Natural Science. Marks in %

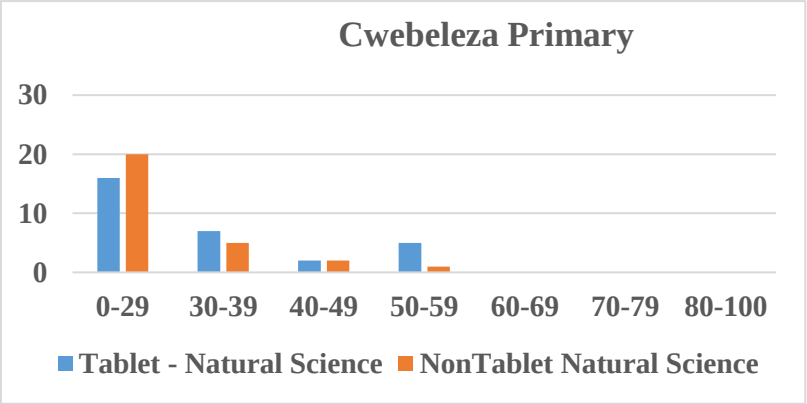
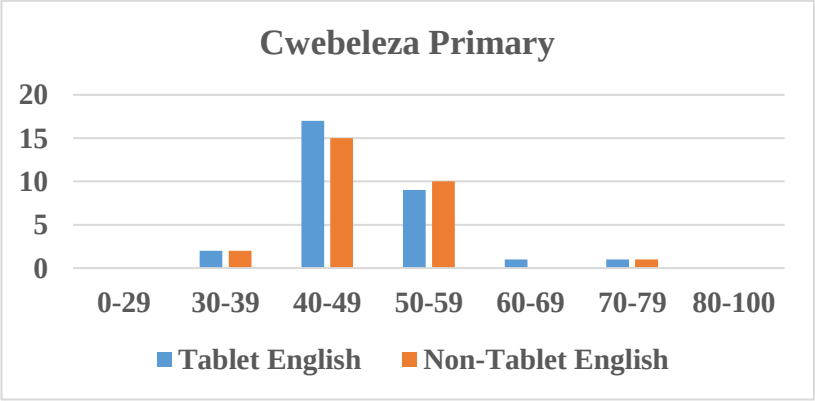


Figure 14: Number of learners in the various performance categories for English. Marks in %



Durban Girls High School June Examination Results

Twenty-nine learners at Durban Girls High School took the June examination in the tablet class and 211 learners in the non-tablet class. Figures 15, 16 and 17 show the number of learners in the various performance categories for Mathematics, Natural Science, and English, respectively. In all the three subjects, all the learners in the tablet classes scored 60% and above, in comparison to the learners in the non-tablet classes. Further, all learners in the tablet Natural Science class scored 70% and above, while several learners in the non-tablet class scored less than 70%. These results show evidence that the learners who used the eLearning research pilot benefitted from its use and consequently, could perform better in the subject than those who were not exposed to the eLearning research pilot.

Figure 15: Number of learners in the various performance categories for Mathematics. Marks in %

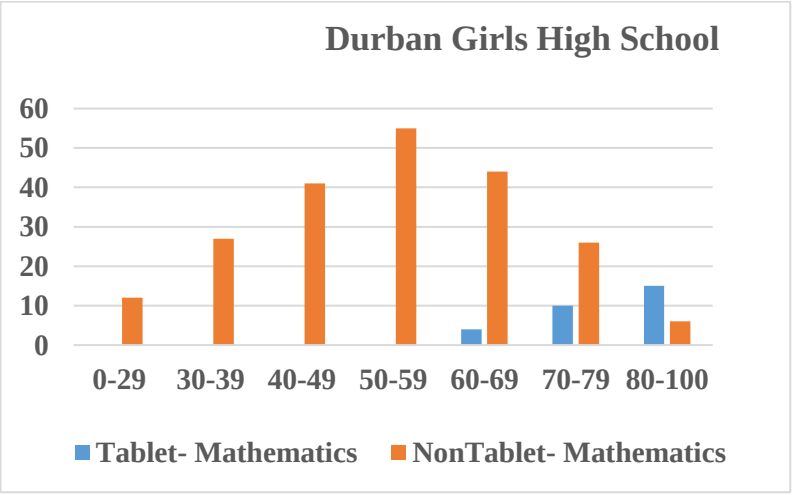


Figure 16: Number of learners in the various performance categories for Natural Science. Marks in %.

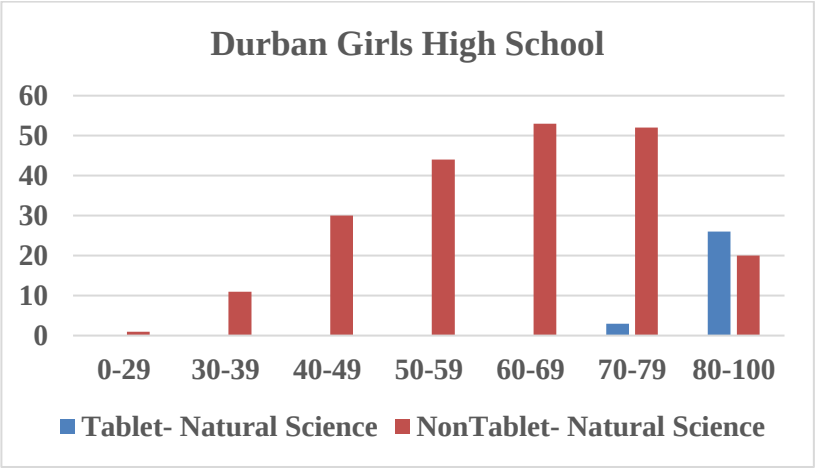
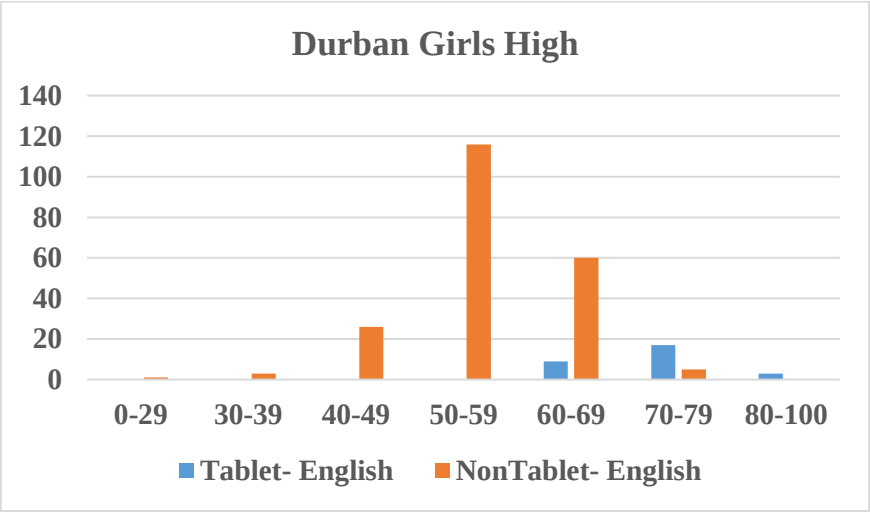


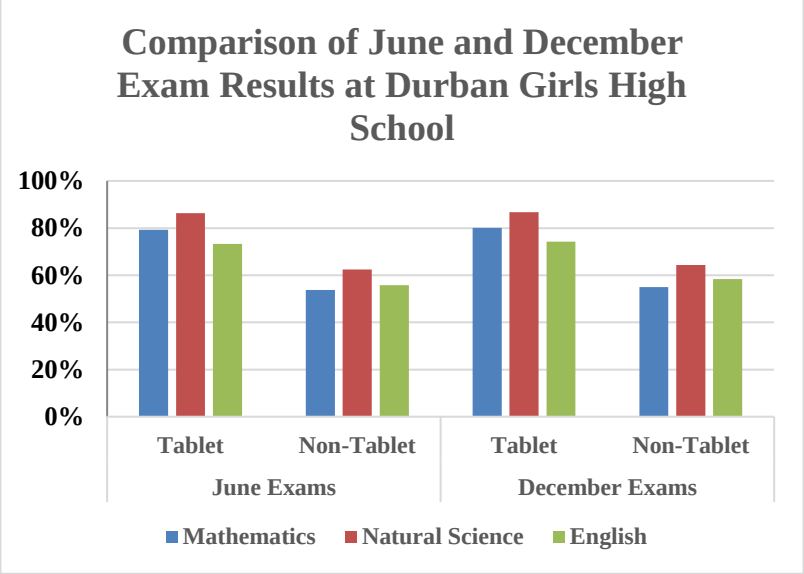
Figure 17: Number of learners in the various performance categories for English. Marks in % on horizontal axis



Comparison of Examination Results between June and December for Durban Girls High School

Figure 18 below shows the comparison of June and December 2015 Examination results across the three subjects at Durban Girls High School. In both June and December, the tablet-classes performed better than the non-tablet classes across all the three subjects. These results show evidence that the learners who used the eLearning research pilot benefitted from its use and consequently, could perform better in the subject than those who were not exposed to the eLearning research pilot.

Figure 18: Comparison of average performance in June and December Examinations results for Mathematics, Natural Science and English at Durban Girls High School

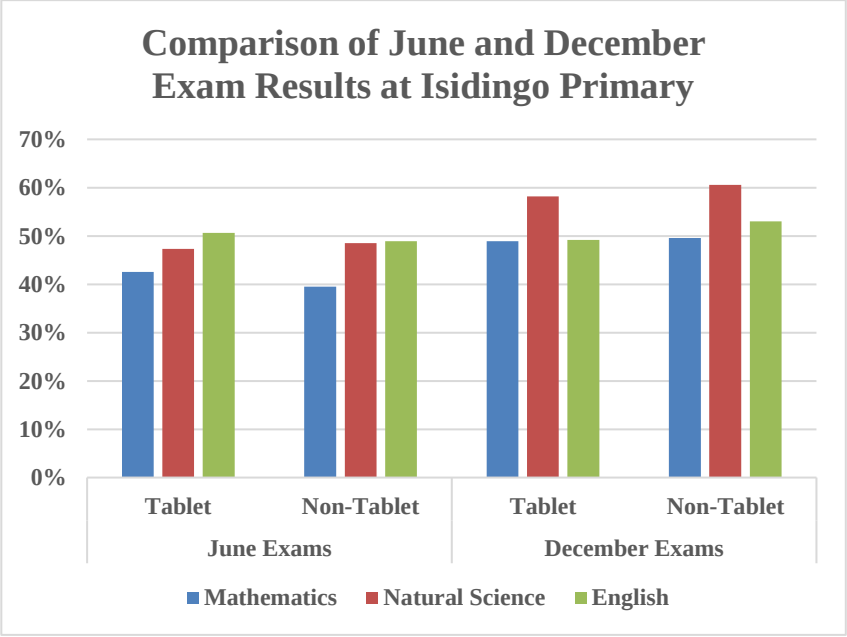


Comparison of Examination Results between June and December for Isidingo Primary

Figure 19 below shows the comparison of June and December 2015 Examination results across the three subjects at Isidingo Primary. The results

show that learners in the tablet classes did not significantly outperform cohorts in the non-tablet classes. Learners in the tablet and non-tablet classes performed either on par with each other or slightly better. The tablet classes did not appear to be negatively affected by the introduction of ICT. In other studies it has been suggested that the positive effects of laptop use appeared only after the second year of a recent ICT implementation study due to the steep learning curve required for both teachers and students experiencing a new 1:1 classroom. This indicates that even though the results at Isidingo Primary did not show significant differences between the tablet and non-tablet classes, this is likely to change with future implementations of the Pearson/MSA eLearning research pilot.

Figure 19: Comparison of average performance in June and December Examinations results for Mathematics, Natural Science and English at Isidingo Primary



An analysis of learner performance in the baseline assessment and post testing assessment shows that across subjects and schools learners in the tablet classes improved their results whereas learners in the non-tablet classes showed a decline in results. The biggest discrepancy being in Grade 7 Natural Science and Grade 8 Maths where learners in the tablet classes notably outperformed cohorts in non-tablet classes.

Conclusion

In this section it is shown to what extent the empirical results enable the researchers to answer the research questions shown below, keeping in mind that the extent to which one can answer research questions in problem solving research is the extent to which one has been able to solve the research problems that motivated the research project.

- *What is the impact of the tablet-based digital content on learners and teachers in Mathematics, Natural Sciences and English?*
- *How did the teachers and learners experience the implementation of the tool?*

Teachers and learners gained confidence in using the eLearning project content, tools and integrating this into their lessons. However, there is still need for training on using some of the digital content and applications. For example, on how to use the Longman HAT language portal, Kingsoft and Microsoft office applications.

- ***How did learners and teachers' access and use the digital content?***

Learners showed increased use of the digital content for class work, searching for information, and collaboration and sharing.

- ***What was the effectiveness of the digital content in assisting the teacher to deliver the curriculum timeously?***

There was an increase in teacher capacity to use the intervention and digital resources. It was also noted that there was a growth in teacher

confidence and ICT literacy skills with a larger number of teachers now comfortable with using the eLearning resources.

- ***What was the standard of learner achievement and competency in terms of subject-specific skills and ICT skills?***

The examination results indicate that the intervention is having an impact on the learners' subject-specific skills. Further, the feedback from the teachers and learners indicate that learners have gained digital literacy not only in using the eLearning solutions, but also in creating knowledge and acquiring problem solving skills. These results show that using technology to foster learning enables learners develop core 21st century skills.

Recommendations

What are the recommendations for sustainable, scalable eLearning models for high quintile and low quintile schools?

This research question is answered by the recommendations highlighted below.

Pedagogy

- The results of the baseline test assessment diagnostic tool indicate that if learners wish to succeed at these subjects by passing, improve or gain access to tertiary studies, the problem areas highlighted in the Test and Improve diagnostic tests should be addressed as soon as possible. Both Science and Mathematics rely heavily on bodies of knowledge in order to build more knowledge. Learners will struggle going forward if they rely on rote learning (memorisation by repetition) for these subjects.
- Differentiated teaching style is most effective. A professional development element focusing in on pedagogy with a digital application is crucial.

E-Learning

- To reduce repetitiveness in content such as Games, these could be designed to adjust according to the learner's level.

- Design eLearning resources that encourage collaboration and sharing among teachers, not just the learners. For learners, there is an opportunity to design collaboration and sharing tools for restricted spaces, such as in libraries or during silent sessions.
- Volume and variety of content included in any eLearning solution should be tailored to user ability. For teachers, the integration of digital content can be at any of the three stages: Stage 1 (not comfortable integrating the digital content in class); Stage 2 (felt comfortable integrating some of the digital content in class); and Stage 3 (felt comfortable integrating the digital content in class). Thus, the teachers at the various stages should be exposed to digital content that suits the stage they are at. As the teachers progress through the three stages, they should be able to select and use additional digital content that suits an advanced level.
- Lesson preparation time may increase with the introduction of eContent. To minimise disruption and maximise learning and teaching time we recommend the following: provide guidance linking digital resources to the delivery of the CAPS curriculum; and provide a search functionality allowing users to search for digital assets per Term, Subject, Grade and CAPS topic.
- Learners are keen to explore content and devices out of class time. An eLearning solution should facilitate learning beyond the classroom and provide for learner driven revision and practice. To implement this, it is recommended that stakeholders work with schools in identifying 'after school' access to technology. Access to mobile friendly content accessible across different devices is further recommended to enable learning beyond the classroom.
- A blended learning approach is the most effective. For example, a library set of hardcopy textbooks per class facilitates continued learning at home.
- A teacher does not need to be a technology expert to facilitate a successful e-lesson. Thus, it is recommended to use learner enthusiasm and technical knowledge to drive change and support teachers. For example, by establishing e-Champion programmes. Since learning does

not always need to be teacher driven, it is recommended to encourage teach back sessions where learners share their discoveries with classmates and teachers.

Training

- Teachers and learners need education regarding ethical and responsible online usage and better understanding of what online means.
- Digital aptitude of users varies hence: user needs analysis to determine focus of training and support is essential; training needs to be ongoing and hands-on for there to be movement from a stage 1 user to a stage 3 user; training programmes need to be tailored for different users (teachers, learners, HODs, IT administrators); and successful teacher training takes technological knowledge, pedagogical knowledge and content knowledge into consideration.

Personal Note by the Lead Author

I was approached by Pearson Education to help identify possible reasons for unexpectedly poor test results in some schools for formerly disadvantaged learners in semi-rural and rural schools around Durban. Consequently I and other fieldworkers attended lessons as silent evaluators to minimise the effect of our presence in classrooms. My *first observation* is that learners at these schools were not adept at using tablet computers loaded with educational content, probably because they were not permitted to use them for individual self-study and Internet access in the classrooms on a regular basis. My *second observation* is that during evaluation sessions I noted with concern the pedagogical practice of educators having learners recite lesson summaries in unison in subjects like mathematics, chemistry and physics. While this approach makes for good discipline in the classroom it confuses memorisation with understanding. From a cognitive point of view personal insight, not rote learning, is the eye of the needle that has to be threaded with knowledge to arrive at real understanding.

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