Evaluation of Success of NEPAD's Pilot e-Schools in Kenya: An overview

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Abstract

This study was conducted to evaluate the success of the pilot phase of the New Partnership for Africa's Development (NEPAD) e-School project in Kenya. The study employedsurvey research methodology. All six of the NEPAD e-Schools in Kenya were included and the teachers and students in those schools formed the study population. Of the 5,186 students and teachers, a representative sample of 1,508 was selected using probabilistic techniques. Data was collected using observations, interviews, and a survey questionnaire. It was established that all six of the e-Schools had installed the basic computing facilities required for integrating Information and Communication Technology (ICT) in teaching and learning and all the e-Schools were observed to have the Very Small Aperture Terminal (VSAT) for internet access in computer laboratories, where a variable number of computers were installed. But while teachers received technical (ICT) training, they did not receive training on pedagogies for ICT integration in teaching and learning. We conducted hypothesis testing and confirmed that six of the seven e-School Success Model's dimensions positively contribute towards the success of the e-School. We, therefore, conclude that the pilot phase of the NEPAD e-School project in Kenya has considerable potential for success. We recommend that stakeholders should continue investing in the NEPAD e-School project. Further studies on the impact of e-Schools are recommended.

Keywords: e-School; e-School success; NEPAD e-School; e-learning; Kenya

1. Introduction

The New Partnership for Africa's Development (NEPAD), through its organ: the e-Africa Commission, is spearheading the development of Information and Communication Technology (ICT) infrastructure on the African continent. The e-Africa Commission was specifically mandated

to manage the structured development of the ICT sector on the African continent (NEPAD, 2005). This mandate entailed six priority projects including: the NEPAD e-School initiative; the low-cost satellite access project for NEPAD's electronic schools (e-Schools); the East African submarine cable project; NEPAD broadband access fibre-optic project for landlocked African countries; the NEPAD capacity building project for e-learning in Africa (based on the Africa Virtual University); and the e-Policies and e-Strategies project (NEPAD, 2005:1).

The e-School initiative is a project aimed at imparting ICT skills on students graduating from both primary and secondary schools in Africa (Evoh, 2007; NEPAD, 2005). In order to achieve this goal, the e-Africa Commission is mandated to coordinate strategic partnerships between technology developers in the private sector and the governments of African countries. To participate in this initiative, governments are required to sign a memorandum of understanding (MOU) with the e-Africa Commission. Private sector partners develop and implement ICT infrastructure and human capacity in schools to facilitate the integration of ICT in teaching and learning. The governments, on the other hand, coordinate resource mobilization (Evoh, 2007; Farrell, Isaacs &Trucano, 2007:18).

The e-Schools are equipped with computers that are interconnected through local area networks (LANs). The individual LANs are then linked via satellite to form a wide area network (WAN) that stretches across the continent**.** The Regional African Satellite Communication Organization (RASCOM), with the support of the International Telecommunication Union (ITU), designed, assembled and launched a satellite - RASCOM-QAF 1 - into orbit to support the e-Africa Commission's activities (RASCOM, 2011). Through RASCOM-QAF 1, rural regions in Africa have been able to access affordable telecommunication services and internet connectivity using VSAT (RASCOM, 2011). NEPAD's e-School initiative was designed to tap into the benefits of connectivity through satellite links and to connect schools in Africa regardless of their location within different national boundaries (NEPAD, 2005).

The NEPAD e-Africa Commission is piloting the NEPAD e-School project in 17 African countries, namely: Algeria, Burkina Faso, Cameroon, Democratic Republic of Congo, Egypt, Gabon, Ghana, Kenya, Lesotho, Mali, Mauritius, Mozambique, Nigeria, Rwanda, Senegal, South Africa and Uganda (NEPAD, 2005). The NEPAD e-School initiative provides a framework for (and a systematic approach to) ICT integration in education on the African continent. The e-School initiative's specific objectives are to: impart ICT skills on students, in order to enable them to participate in the knowledge society; enhance teachers' capacities through the use of ICT in teaching; and improve school management and increase access to education (NEPAD, 2008).

The main research problem of the study was to determine the level of success of the pilot phase of NEPAD's e-Schools in Kenya. NEPAD (2004) estimated that by the end of 2008, each youth graduating from an African high school would be ICT-literate and by the end of 2013, each child graduating from an African primary school would be ICT-literate through the e-School initiative. This projection was made at the launch of the pilot phase in 2003. Project piloting was to last only one year to give way to full scale implementation, which is now behind schedule. It is not clear what caused the project to fall behind schedule. Farrell (2006) reported, in the initial interim report of NEPAD's pilot e-Schools' evaluation, that the project had encountered serious challenges,

some arising from the e-Africa Commission's failure to meet its leadership responsibilities. Soon after the launch of the pilots, the NEPAD e-Africa Commission left all of its activities to the consortia. The consortia in the NEPAD e-School pilot in Kenya were formed by teams of ICT experts from Microsoft and Oracle. These teams worked closely together in coming up with a common structure for the e-School. The ceding of leadership to consortia members may have resulted in variations in the interpretation of the mission of the project.

One of the critical benchmarks in the project was to empower teachers with ICT skills. The trained teachers would in turn train their colleagues in a cascading model and also induct students in the use of ICT systems. Since the e-Africa Commission ceded leadership to consortia members, there is uncertainty as to the quality and relevance of the training that the teachers and students receive. Evoh (2007) rightly pointed out that the goals of the NEPAD e-School initiative are idealistic. The NEPAD e-Africa Commission expanded the aims of the e-School beyond what was initially envisaged. Broadening the aim of the project potentially relegated key objectives, such as the integration of ICT in teaching and learning.According to O'Neil (2002), "While many people who have experience in the use of ICTs see at least some potentials of their use in improving some aspects of the society, little objective research exists that can back up these claims." Furthermore, the cost of the implementation of e-Schools is very high. According to Farrell (2006), one consortium estimated the cost of setting up a single e-School demonstration at USD 4.8 million. Such costs should be incurred only when the benefits of the programme justify the investment.

2. Purpose of the study

The overarching aim of the study was to undertake an empirical evaluation of the success of NEPAD's pilot e-Schools in Kenya. The specific objectives were to: establish the ICT infrastructure installed in the e-Schools; determine the infrastructure's quality, accessibility and suitability for enhancing teaching and learning; investigate the effectiveness of the training imparted on teachers and students; establish the extent to which e-School infrastructure is being used to enhance teaching and learning and in providing health information; determine the extent to which the e-Schools were preparing students to function in the global economy; and establish the extent to which the e-Schools improve the efficiency of school management and the processes of teaching and learning. For every objective, a set of two or more hypotheses were tested to facilitate the confirmation or disconfirmation of its contribution to the success of the pilot e-Schools in Kenya.

3. Methodology

The study employed survey research methodology. All six of the NEPAD e-Schools in Kenya were included. Chevakali High School, Isiolo Girls Secondary School, Maranda High School, Menengai Secondary School, Mumbi Girls Secondary School and Wajir Girls Secondary School and the teachers and students in those schools formed the study population. Of the 5,186 students and teachers, a representative sample of 1,508 was selected using probabilistic techniques that involved stratification based on the class level (forms I, II, III and IV) and gender in the case of Menengai Secondary School. The study investigated seven dimensions of the e-School system, namely: (i) Infrastructure quality, (ii) Content and communication quality, (iii) Service quality, (iv) Training effectiveness, (v) Use, (vi) Teachers' and learners' satisfaction, and (vii) Net benefits. Invariably, students and teachers interacting with the e-School systems were included in the study. Only one of

the six schools, Menengai High School, enrolls both genders. Chevakali and Maranda High Schools are male only schools, while Isiolo, Mumbi and Wajir Secondary Schools are female only schools. Table 1 shows the sample of students, while Table 2 shows the sample of teachers.

Table 1: Sample of students

School	Percentage Composition		Stratified Sample		Sample size
Gender	F	M	F	M	
Chevakali High School	0	22	0	314	314
Isiolo Girls Secondary School	9	0	119	0	119
Maranda High School	0	26	0	371	371
Menengai High School	7	14	100	200	300
Mumbi Girls Secondary School	12	0	171	0	171
Wajir Girls High School	10	0	143	0	143
Total	38	62	533	885	1418

Table 2: Sample of teachers

School	**Total**	**Sample Size**
Chevakali High School	59	18
Isiolo Girls Secondary School	23	10
Maranda High School	58	21
Menengai High School	55	17
Mumbi Girls Secondary School	28	13
Wajir Girls High School	27	11
Total	250	90

Each of the six schools had students enrolled in forms one, two, three and four (Grades 9, 10, 11 and 12 years of education). The number of students enrolled varied from one school to the next depending on the number of class streams established in the school, which ranged from two to five. Both male and female teachers were employed in the schools. There were no guidelines that governed the distribution of male and female teachers in a school. However, the population of female teachers was high in schools close to towns and very low in schools in the perceived hardship areas (eastern and north eastern regions). Data was collected using observations, interviews and a survey questionnaire. Observations were made on the infrastructure installed in the e-Schools with specific attention paid to computer laboratories, computer hardware, networking accessories, and presentation and communication equipment. The interviews were conducted with the principals of the e-Schools, while self-administered questionnaires were hand-delivered to students and teachers.

The collected data was edited and cleaned. An analysis of quantitative data was done using the Statistical Package for Social Sciences (SPSS) together with Microsoft Excel, while qualitative data was analyzed using content analysis. Descriptive statistics and non-parametric tests assisted with the rejection or acceptance of the hypotheses.

4. Results and Discussions

The findingsand discussions are summarised in sub-sections 4.1 to 4.5 that follow.

4.1. ICT infrastructure installed in the NEPAD e-Schools

The following three hypotheses were tested:

- Hypothesis1: The quality of the installed e-School infrastructure (the IS) determines the level of success of the e-School;
- Hypothesis 2: The quality of information content and communication contributes to the level of success of the e-School; and
- Hypothesis 3: High service quality offered by the technical personnel contributes to the success of the e-School

4.1.1. The quality of the installed e-School infrastructure (the IS) determines the level of success of the e-School

Data collected through observation revealed that all six of the e-Schools had installed the requisite infrastructure for integrating ICT in teaching and learning. This infrastructure included: computer laboratories fitted with computer workstations, computer servers, local area networks (LANs), computer printers, smart television sets, smart boards, LCD projectors for displaying information, VSAT for satellite links, and power sources with back-up generators in some of the e-Schools. The computers were installed only in computer laboratories in all the schools except Chevakali High School, where a few computers were installed in some classrooms. This arrangement restricted access to computers in the e-Schools as students could only access the computer laboratories a few times in a week and only during scheduled lessons.

The restricted access to e-School resources makes it difficult to integrate ICT in teaching and learning (Sa´nchez, Salinas & Harris, 2011). In an ideal situation, teachers should use information and communication technology as a teaching platform in everyday classroom teaching. This was not possible in these e-Schools as ICT infrastructure had not been extended to the classrooms. Such limitations are not unique to the pilot of NEPAD's e-Schools. Other e-School programmes, for example- the Malaysian Smart Schools: the Scholar's programme of the United Kingdom and the Enlaces programme of Chile, all rely heavily on the use of computer laboratories (Hinostroza, Labbe, Brun&Matamala, 2011; Beacham, 2011; Hamzah, Ismail &Embi, 2009). Students should

interact with peers and teachers after class or during recess. It is during this time that teachers could coach individual students on lower or higher level tasks depending on the individual student's capacity. Such arrangements would only be possible if there are large laboratories open to students all the time or if workstations are distributed to the classrooms.

The workstations were in good working order. However, in all the e-Schools, the VSATs had been disconnected from the satellite link due to non-subscription. As a result, access to the internet was restricted for scheduled lessons as it was achieved throughdial-up connections through the main server. It provided students with access mainly during class teaching . Students who were in school before the year 2009 (one year before data collection) enjoyed access to the internet because at the time, VSAT connections were still live. Those students had, therefore, experienced interacting with peers and even teachers online. Online interactions are cardinal to the achievement of the overall objective of the e-School, particularly because it enhances use of e-School resources (Sife, Lwoga & Sanga, 2007) and its termination is bound to adversely affect the success of the e-Schools.

In some of the e-Schools, the printers that were in use were products of Lexmark. While the printers were in good working order, they had run out of toner, which the schools could not replenish because there was no dealer of Lexmark printers in Kenya. According to the e-School principals, attempts to purchase stock from neighbouring countries failed as the supply for the printer model Lexmark X422 was hardly available, even in countries such as South Africa with distributors of Lexmark printers. Consequently, the e-School users did not attain hands on experience with computer printing.

Despite the challenges of infrastructure, the e-School users were satisfied with the quality of the installed infrastructure. The satisfaction level was relatively lower in Maranda High School and Menengai Mixed High School. These two schools had a very high student to computer ratio. In Maranda, it had taken a very long time for a second computer laboratory to be built and fitted, despite a population of over 1,300 students in that school. It later became apparent that in these two schools, access to computers was restricted to students registered for the ICT course only. This was a real source of dissatisfaction amongst the students. Overall, the teachers and students in the e-School agreed that the quality of infrastructure was good. Statistically, the chi-square for all the variables weresignificant with p values below 0.05, which supported the rejection of the null hypotheses. Consequently, it was concluded that the quality of the installed ICT infrastructure in the e-Schools contributes towards their success.

4.1.2. The quality of information content and communication contributes to the level of success of the e-School

The study established that while the content quality of the e-Schools was good, communication effectiveness was not of a high quality. The e-School users could efficiently retrieve and read materials through the e-School and the content retrieved from the e-School LAN was relevant to the curriculum. Similar studies have also underscored the importance of the quality of electronic content. In an evaluation of ICT as a tool for enhancing teaching and learning in the United Kingdom, Rogers and Finlayson (2004:301) established that 70% of the teachers felt that the content retrieved from the internet had the potential to clarify subject matter and promote thinking. However, even while the internet contains vast reading materials covering virtually all subject areas,

new users of the system can easily suffer from information overload. Thus, if useful sites were selected and filtered for secondary school students, the resources would be more useful to their learning. Lack of the right content actually delimits the success of self-directed learning.

Communication was good for the students who were at the schools when the consortia installed and maintained the system between 2005 and 2009. After 2009, when the consortia members withdrew their services, allegedly because their contracts were not renewed, communication became a challenge, particularly with the disconnection of the VSATs through which the e-Schools could access the internet. The e-Schools' management subsequently restricted access to the internet on account of cost. The schools relied on dial-up connections through the servers. Dial-up connections are charged based on the download bandwidth consumed and are, therefore, costly to maintain. In a similar study on the pedagogical integration of ICT in Uganda, Ndidde, Lubega, Babikwa and Baguma (2009) identified cost as the main obstacle to internet connectivity in schools. With limited internet access, the exchange of ideas between peers in different e-Schools is curtailed. For the same reason, students could not make many new friends through the network of e-Schools like they used to when internet access was unrestricted.

Despite the challenges cited with respect to communication and content, the null hypothesis was rejected on the grounds that the chi-square statistics revealed that all the observed frequencies of the variables were above the minimum expected frequencies and that all the test statistics had a p value of 0.000, which is less than the set value of 0.05 for this study. Therefore, this means that information content and communication quality is positively contributing to e-School success.

4.1.3. High service quality offered by the technical personnel contributes to the success of the e-School

In order to maintain the usability of the installed infrastructure, deliberate efforts have to be made to maintain the system. Every e-School had at least one technical person to maintain the system and provide user support. The quality of the services offered by the technical staff was adequate. The technical personnel's knowledge of the e-School exceeded the expectations of the users (teachers and students). However, teachers' and students' expectations were not met in the attention provided to them and the promptness of the technical staff's response to teachers' and students'requests for user support.

The knowledge gap between most of the users and the technical staff was certainly wide. Most of the users were encountering the e-School system for the first time, while the technical personnel were professional users of ICT. However, the number of technical staff was small, which posed a challenge to providing individual attention to the e-School users. In service sectors such as banks, it has been established that service quality is improved with more customer-care personnel (Newman, 2001). It is, therefore, understandable that the attention provided to students and teachers and the promptness of the response was below the expectation. Nevertheless, in this study, service quality had a favourable rating of 65%.

Overall, the significance levels of the chi-square values for all the variables, except the knowledge gap between users and technical personnel, were 0.000, which is less than the set p value of 0.05. The p value for the knowledge gap between users and technical staff was 0.115, which is not significant and therefore supports the assertion that the technical personnel were knowledgeable about the e-School system. Even though there was a gap between user's expectations and actual service delivery in respect to timeous service and the approach to users' issues, users expressed satisfaction with the service quality. This combination supported the rejection of the null hypothesis. The overall results confirm that the service quality of technical personnel is positively contributing to e-School success.

4.2. Effectiveness of the training imparted on teachers and students for access and use of ICT infrastructure in teaching and learning

Here, we tested one set of hypothesis:firstly, the hypothesis that effective training method and approach contributes to the success of the e-School system and secondly, the null hypothesis that effective training method and approach does not contribute to the success of the e-School system.

The e-School users received training on the use of the e-School infrastructure. A few teachers (ICT teachers) were taken to training seminars by the Kenya Chapter of the e-Africa Commission. It was envisaged that these ICT teachers, also known as ICT champions or coordinators, would in turn train other teachers in their schools and also induct students in the use of the e-School.

Training was conducted using a variety of methods including lectures and demonstrations, with the latter taking center stage. Wide use of the demonstration method supports the finding that most trainees attained hands-on experience. Demonstrations, as behavior modeling techniques,are known to have a greater impact on computer self-efficacy (Chou, 2001). Hands-on experience is particularly important as the e-School users are expected to be independent. E-learners and, therefore, e-School users should be accustomed to independence. This is necessary to enable them to operate in environments where there is limited user support. Much work has been done towards this in the form of personalized services (Chen, Lee & Chen, 2005). Reliance on user support may result in disruptive frustration when such support is not forthcoming. It was, however, revealed that many users were looking forward to additional training. This is very revealing, particularly in the case of teachers. The training of both teachers and students was done to equip them with technological skills. The training imparted on teachers did not take into consideration the need to equip teachers with pedagogical skills that are suitable for the integration of ICT in teaching and learning. It is, therefore, not surprising that students disagreed with the suggestion that they received coaching from their teachers through the e-School.

Training was conducted over a short period of time. Given the large number of new students registered every year and the few workstations available, the period of training had to be shortened to just one day for a group of students per year.This was certainly inadequate, particularly for students who were interacting with ICT hardware and software for the first time. Within the short period the training was given, valuable time was sometimes lost due to interruptions to the power supply and trainers' need to slow down to accommodate the most disadvantaged students. In most settings, trainees shared computers which further limited the time for hands-on experience. Nevertheless, trainees obtained basic skills in the use of the e-School.

According to students and teachers, the trainers had reasonable knowledge of ICT operation. However, the trainers did not keep up with evolving information technologies. This became evident from the insights of the e-School users who had prior training outside the e-Schools. This group of trainees occasionally faulted the trainers and could identify the limitations in their experiences with the trainers. A good proportion of the e-School users who had been trained said that they required additional training. However, the group of users who required additional training were statistically different (chi-square = 42.8; p = 0.000) from the group that had obtained hands-on experience during training. It is therefore evident that those who seek additional training do so because they did not benefit from the initial training for different reasons. This supports the rejection of the null hypothesis and reinforces the proposition that training effectiveness contributes towards e-School success.

4.3. E-School infrastructure usage

In this case,we hypothesized that high and usage of the e-School system contributes towards the success of the e-School system and the corresponding null hypothesis that high and usage of the e-School system does not contribute towards the success of the e-School system.

The e-School is being used by both teachers and students. The respondents in this study accessed the e-School regularly, irrespective of their gender and role as either teacher or student. A key aspect, which has encouraged the use of the e-School, is that it is easy to use, to the extent that even learners who had never encountered it before, but who had obtained hands-on experience with ICTs elsewhere, did not experience any problems. Despite wide usage, teachers did not incorporate the use of ICT in everyday classroom teaching. This was partly because the infrastructure had not been diffused to classrooms and also because teachers' pedagogical skills in inquiry-based learning were inadequate.

The users relied on the e-School to access materials supporting the curriculum. At the time of writing, users could only access such materials from within the e-School LAN. Materials from other e-Schools and sources outside the LAN could not be accessed due to inadequate internet connectivity. The restricted internet connection had also curtailed collaboration between peers in different e-Schools. Some users accessed material which was irrelevant to the approved curriculum. Most of the users who accessed such material were teachers and they did so through dial-up connections to the internet. Students' access to irrelevant material was restricted by rules and limited access time.

The e-Schools' management had instituted various rules to streamline the system's use. Some rules on the use of the e-School were, however, de-motivating users from innovatively or exploitatively using the e-School system. One of the principal de-motivators in the use of the e-School was the low user to computer ratio. In many cases, users shared workstations, a situation which is incompatible with independent learning activities. This is the prevailing situation in most countries that are integrating ICT in teaching and learning (Enlaces, 2009; Beacham, 2011).

No student users could recall ever seeking health information through the e-School. Material on health information was never incorporated into the e-resources within the LANs. It was also evident that teachers had not directed students to seek health information. In the Kenyan education system,

there is no subject on health education at secondary school level, making such material irrelevant to the curriculum and therefore less attractive to students. The few e-School teachers who had accessed health information did so by searching the internet through dial-up connections. The chi-square test statistics for all the variables in this dimension had values ranging between 33.86 (access material not relevant to the curriculum) and 264.1 (e-School is easy to use), all recording a significance level of 0.000. The null hypothesis was therefore rejected, confirming that high and exploitative use of the e-School contributes towards e-School success.

4.4. Perception of e-School users (students and teachers) on its preparation of students to function in the global economy

We argue that: High level of satisfaction of teachers and students with the e-School system (all aspects including: system quality, content and communication quality, use, and exploitation and training) contributes to the success of the e-School system and the counter argument is that : High level of satisfaction of teachers and students with the e-School system (all aspects including: system quality, content and communication quality, use, and exploitation and training) does not contribute to the success of the e-School system.

The e-School users were highly satisfied with most of the variables of user satisfaction. Out of fourteen variables, users' satisfaction was significant with eleven variables (78.57%) with relatively high chi-square values (between 26.17 and 205.01). The most satisfying variable was ease of use of the e-School system - 90.65% of the teachers and students expressed satisfaction, with an accompanying chi-square value of 205.01. Of the eleven variables, with a significant level of satisfaction, the lowest ranked was the availability of content that meet users' needs. This variable was only weakly supported by 49.4% of the teachers and students with an accompanying chi-square value of 26.17.

However, there was dissatisfaction with three variables, namely: the ability of the e-School system to facilitate discussion between students, their peers and teachers; sharing what students learn with the learning community; and overall satisfaction with the e-School. This dissatisfaction is also expressed in the numerous complaints raised by users. Issues that users complained about include: inadequate infrastructure, poor maintenance of the e-School, unreliable internet, and virus infection. Another complaint was students' dislike for being forced to remove their shoes before entering the computer laboratories. This was allegedly practiced to reduce the dust level in those laboratories. The dissatisfaction with these variables was strong enough to dissuade the rejection of the null hypothesis. Therefore, in effect, the study established that the high level of satisfaction of teachers and students with different aspects of the e-School is not contributing to the success of the e-Schools.

4.5. E-School improvement of the efficiency of school management and the processes of teaching and learning

Our last argument in this case was that: Net benefits of IS contribute to the success of the e-School system and with the counter argument that: Net benefits of IS do not contribute to the success of the e-School system.

The public has a favourable opinion of the e-Schools. Parents of most students in the e-Schools preferred them to other schools. The parents felt that the e-Schools have better facilities and offer good learning environments for the students. Teachers, however, did not seem to share the same view. The integration of ICT into teaching and learning is a platform that requires teachers to abandon their traditional methods of teacher-centered instruction, where teachers are the gatekeepers of knowledge and students are the passive recipients of knowledge. It also requires teachers to learn new techniques, which may be viewed as a burden by some teachers.

The study established that the e-School helps students perform better, to some extent, in their examinations, makes learning and teaching more enjoyable, and encourages independent learning**.** This finding was, in varying degrees, supported by respondents in the sample. Academic performances of the individual students in some of the e-Schools improved as they continued to engage with the e-School and the overall performance of those schools also improved in national ranking. However, a performance decline was visible in Isiolo Girls High School and Wajir Girls High. The cause of this decline could not be established in this study.

The e-School was found to have some influence in teamwork between students and between students and teachers within and between the e-Schools. Teamwork skill was enhanced more by interaction within an e-School's LAN. The between e-Schools effect was very little due to limited internet access. The e-School was also said to encourage independent learning and therefore contributes to the capacity for lifelong learning. Both teachers and students felt that the e-School provides students with the ability to practice lifelong learning. The chi-square statistics, however, revealed that whereas the level of perceptions were significant in all the variables, the chi-square value was lowest for collaboration between teachers and students (chi-square = 53.1) and improvement in teamwork skills (chi-square = 89.2). This resonates with the findings of similar variables under the user satisfaction dimension that these perceptions were only weakly supported (48.1% for collaboration and 45.2% for teamwork skills).

The e-School has facilities for teaching, learning and management. It was established that the e-School infrastructure helps in the efficient use of resources. Thus, the deployment of resources in the e-Schools is more efficient than in other schools. In particular, reporting is made more effective. Teachers may prepare accurate student academic reports in a timely manner and school administration has data which is used to generate reports to the centralized government administration.

Numerous other benefits of the e-School were listed by the respondents. The most commonly perceived other benefits were gaining computer literacy, making and connecting with new friends, and improved understanding of the subject content. There is also the opportunity to use the system to identify possible job vacancies.

On the strength of chi-square statistics, the null hypothesis was rejected. This means that the net benefits are contributing towards the success of the e-Schools. The NEPAD e-School was therefore found to be accruing benefits similar to those that have been identified in similar programmes in other countries, including Britain's Scholar (Simpson, Payne &Condie, 2005) and the Malaysian Smart School (Ya'Acob, Nor, &Azman, 2005), among others.

5. Conclusion and recommendations

The study established that all six of the e-Schools had installed the basic computing facilities required for integrating ICT in teaching and learning. All the e-Schools had VSAT for internet access via satellite in computer laboratories where a variable number of computers were installed. The computers were networked using structured cabling into a LAN, and the LANs were linked into a WAN through the VSATs. The computer laboratories also had smart televisions, smart boards and LCD projectors. It was further revealed that students and teachers were trained in the use of e-School infrastructure and they were using the ICT infrastructure for teaching and learning. Students found learning with integrated ICT enjoyable, and it appeared to improve their performances. Using document analysis, performance improvement was confirmed in four out of six of the e-Schools. Two e-Schools experienced a decline in academic performance over the period from 2005 to 2010. It also seemed as though e-School infrastructure had enabled students and teachers to collaborate and had contributed to their teamwork skills.

By testing hypotheses, the study revealed that six of the seven dimensions of the E-School Success Model (Nyagowa, Ocholla, &Mutula, 2011) contribute towards the success of the e-School. It was established that the user satisfaction dimension does not contribute towards the success of the e-School. Three variables for measuring the user satisfaction dimension - the ability of the e-School system to facilitate discussion between students, their peers and teachers; sharing what students learn with the learning community; and overall satisfaction with the e-School - were poorly rated and could not support the rejection of the hypothesis that high user satisfaction does not contribute to the success of the e-School.

The current study empirically evaluated the e-School pilot in Kenya and focused more attention on the original NEPAD e-School objectives to establish the level to which the project was succeeding. This approach is believed to be more focused, detailed and academic-oriented than the monitoring and evaluations hitherto undertaken by the Commonwealth of Learning (COL), thereby adding value to the monitoring and evaluation (M&E) inbuilt in the pilot phase of the NEPAD e-School initiative. The results of this study should inform the e-Africa Commission on the suitability of e-School infrastructure; content and communication quality; training effectiveness for the NEPAD e-School vision; use of the infrastructure for ICT integration in teaching and learning; the users' satisfaction with the infrastructure; and the benefits of the e-School project from the perspective of students and teachers. The study will also be useful to those looking for expert opinion on e-School systems (NEPAD, 2008). Theoretically, the study contributes to discussions and debates surrounding IS success evaluations.

We concluded that the NEPAD e-School project in Kenya has considerable potential for success. Having identified the aspects limiting its level of success, it was recommended that stakeholders should continue investing in the NEPAD e-School project as the gaps highlighted in the study are addressed. The costs of deploying e-Schools at national level are very high (Enlaces, 2008). However, with the knowledge of the potential of e-Schools established in the current study, governments, particularly the Kenyan government, should consider taking on the challenge and expanding the programme to more schools in a phased approach. This could be achieved by introducing at least one e-School in each county (new description of administrative regions in

Kenya) every year, as well as inviting the public and private sectors to participate in the expansion of ICT infrastructure for the more rapid uptake of e-Schools. The government could also develop policies that ensure that the desired skills are incorporated in teacher in-service training, as in the Chilean case (Kozma, 2008), or teacher education curricula, as in the UK. The government could also encourage teachers to attend training by providing the teachers with incentives. Further studies on the impact of e-School are recommended.

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