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Information and communication technology integration: Where to start, infrastructure or capacity building?

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Abstract

The e-Education policy in South Africa highlights the importance of information and communication technology literacy and demanded that every schoolgoing learner be ICT-savvy by 2013. However, the policy does not present implementation strategies; the challenge is that most schools still lack technology equipment for teaching and learning, and teachers are not yet fully equipped with the knowledge and skills to integrate technology into the curriculum. Using qualitative case study design, this study explores the challenges facing and successes relating to technology education with respect to the conditions essential to a technology integration framework. The findings revealed the availability of infrastructure as well teachers who lack relevant computer technology knowledge and skills. The study recommends capacity building as of major priority.

Keywords: Infrastructure, technology-savvy, hardware, software, technology literacy

1. Introduction

The increasing popularity and accessibility of the internet and internet-based technologies, along with the need for a diverse group of students to have alternative means to learn effectively, pose a formidable challenge for schools to teach and learn using technology. This challenge also applies to developing countries like South Africa. One of the policies in South Africa, "the e-Education policy", poses some remarkable challenges with regard to teaching and learning using technologies. The policy highlights the importance of information and communication technology literacy and therefore demanded that every learner in the General Education Training (GET) and Further Education Training (FET) bands be information and communication technology-savvy by 2013. However, the policy made a demand ─ but it failed to arrive at the implementation strategies that will drive this demand. Despite the availability of the ICT policy in South Africa, it is assumed that the majority of educators in South African schools have not been sufficiently prepared during their college years to integrate technology into their teaching. Therefore, buying computers and software for schools and connecting them to the internet does not automatically imply effective uses for technology. Based on the current situation at school levels, many students lack sufficient information and communication technology knowledge to work on their own, to surf the web and to gain valuable information.

The challenges to technology integration in teaching and learning in South Africa are well documented (Assan & Thomas, 2012; Ramorola, 2010; Wilson-Strydom & Thomson, 2005). However, limited research has been conducted on the successes of integrating technology into teaching and learning. This study attempted to explore both the challenges facing and successes relating to integrating technology into the curriculum as perceived by a

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sample of two secondary schools in the Gauteng province of South Africa. The question that was asked was "Where is our starting point, infrastructure or capacity building?" To answer this question the following objectives were designed within the framework of ISTE (2009) and Roblyer (2006):

- to determine if teachers have access to technology equipment

- to investigate if teachers are trained to use technology for teaching and learning activities

- to find out if there are ICT policies to support the curriculum

The rationale behind this question was to provide data to develop a heuristic that would provide guidelines to government, schools, non-government organisations (NGOs), and other ICT facilitators when implementing ICT within a similar context.

2. Conceptualising the integration of technology into the curriculum

The use of information and communication technology (ICT) in implementing a standards-based school curriculum is being articulated in the wider context of educational reform as the acquisition of 21st century skills, i.e. information and communication technology skills and lifelong learning abilities (Law, Lee & Chow, 2002). The rapid growth in ICTs has brought about remarkable changes in the 21st century and affected demands by the modern society. ICT is becoming increasingly important in our daily lives as well as in educational systems (Demirci, 2009). Educational reform involving technology integration is often directed at changing the teaching methods of educators or modifying the delivery of the product to students. According to Demirci (2009), teacher, textbook, and blackboard were the three most significant components of teaching and learning in the classroom not more than a few decades ago. These components compelled teachers to teach the way they were taught (Mehlinger & Powers, 2002; Wachira & Keengwe, 2010) and the infusion of technological tools into instruction poses unique challenges to instructors who are not ready and willing to change to modern constructivist teaching styles.

Today's classrooms are often equipped with computers, access to the internet and projectors that allow the role of teachers to move from a traditional one to that of facilitator in the classroom (Paraskeva, Bouta & Papaginanna, 2008). Teaching no longer centres around the transfer of knowledge from teacher to student; learning comes from student inquiry, critical thinking, and problemsolving based on information accessed from a variety of sources. Increased demand is therefore being placed on educational institutions to use ICT to teach the skills and knowledge that students need for the 21st century.

Historically the concept of information and communication technology integration as an approach evolved as a reaction to early computer-in-schools programmes where the emphasis lay on developing computer literacy or technical knowledge of computers and the use of various computer applications (Wilson-Strydom & Thomson, 2005). More recently information and communication technology integration has been recognised as using computers to learn, rather than learning to use computers (UNESCO/COL, 2004). Technology integration is a complex phenomenon that involves understanding teachers' motivations, perceptions, and beliefs about learning and technology (Woodbridge, 2004). It is recognised that there is a lack of computer technology integration throughout the education system (NCES, 2007). Integrating technology into the curriculum requires knowledge of the subject area, an understanding of how students learn and a level of technical expertise (Morgan, 1996). This implies that teachers need to be comfortable with computers in order to use or integrate them in their courses (Milone, 1999; Wang, 2000). According to Wachira and Keengwe (2010), technology integration means incorporating technology and technology-based practices into all aspects of teaching and learning specifically, incorporating appropriate technology in objectives, lessons, and assessment of learning outcomes. Technology in the context of teaching and learning involves the use of computers with appropriate educational software.

Integration of technology can be achieved when students learn with computers in ways that include using computers efficiently and effectively in the general content areas which allows them to learn how to apply computer

skills in a meaningful way, using real-life software applications that will help students learn to use computers flexibly, purposefully and creatively; when the curriculum drives technology as opposed to technology driving the curriculum; and when the goals of curriculum and technology are organised into a coordinated, harmonious whole (T.H.E Journal, 1999). By only focusing on how to use computers, and by not dealing with the issue of how to teach students more efficiently, the use of computer technology integration into education has failed (Naicker, 2011). Given these definitions, a recent study conducted in the Ghanaian second-cycle schools (Buabeng-Andoh, 2012) revealed that the hardware frequently used by teachers was the computer, and the software mostly used for integration was word processing. Teaching with technology is not simply adding technology to the existing teaching and content domain. True technology integration involves understanding and developing sensitivity to the dynamic, transactional relationship between the three components of knowledge: technology, pedagogy, and content as modelled in the Technological Pedagogical Content Knowledge (TPCK) framework (Koehler & Mishra, 2005). To successfully integrate computers in education, the education system needs to be changed or to be adjusted accordingly (Majeed & Othman, 2012).

3. ICT in the South African education system

Many studies report failure in different countries to incorporate information and communication technology into educational systems (Keengwe, Onchwari & Wachira, 2008). Technology has not fulfilled its potential to bring significant and desirable changes in education (Ginserb & McCormick, 1998). It is mostly underutilised, and has not been implemented in very effective or creative ways and the majority of teachers do not integrate computer technology into their curriculum (Keengwe et al., 2008). A report by the National Centre for Education Statistics (2000) indicated that 44% of teachers used technology for classroom instruction, 42% for computer applications, 12% for practice drills, 41% required research using the internet, 27% had students conduct research using CD-ROMs, 27% assigned multimedia projects, 23% assigned graphical presentations of materials, 21% assigned demonstrations, 20% required students to use technology to solve problems and analyse data, and 7% assigned students to correspond with others using the internet. These low figures imply that effective integration of computer technology into classroom instruction has yet to be realised (Keengwe et al., 2008).

Based on the given report, positive outcomes of using technology in education have led many governments to initiate programmes for the integration of technology into schools (Demirci, 2009). In South Africa education programmes have addressed the challenge of producing computer-literate educators in various ways and at different rates across the nation. The government, the private sector, parastatals and non-government organisations have responded positively to the challenge. Efforts include the following (DoE, 2003):

The importance of teacher readiness and teachers' willingness to participate in professional development cannot be underestimated. SCOPE, School Net SA and the South African Institute for Distance Education have developed 11 Educator Development modules for introducing ICTs into schools. School Net SA provides online, mentor-based in-service training for educators on introducing ICTs into the curriculum and management; and the INTEL "Teach to the Future" Educator Development Programme provides educator training in ICT integration into teaching and learning. Mindset developed content resources and makes these available via satellite television, internet multimedia and print supplements. An educational portal initiated by the Department of Education provides digital content resources. Microsoft has donated software and provides educator development and support.

The Digital Partnership Programme provided schools with 188 000 refurbished computers and 20 000 laptops. In addition, SENTEC is obliged to provide 500 schools with computer labs and educator development through licensing obligations. The 1800 MHz/3g Frequency Spectrum available to mobile operators obliges them to provide universal services to schools, and the Telkom Foundation has established Supercentres in more than 1 300 schools, providing computers, software applications, internet connections, monthly subscriptions and rent-free telephone lines. The Telkom Foundation, together with Telkom's strategic partner 'Thintana' has committed over R200m to support education and training in the areas of ICT, mathematics and science.

Despite the increased availability of computers, support for classroom use and the promise of technology in education, it is doubtful whether teachers are prepared to use them for educational purposes. In support of this notion, Table 1 shows the national statistics of schools with computers by province.

Table 1: Schools with computers by province (adapted from DoE, 2002)

Provinces	Schools with computers	Schools with computers for teaching and learning
Eastern Cape	8.8%	4.5%
Free State	25.6%	12.6%
Gauteng	88.5%	45.4%
KwaZulu-Natal	16.6%	10.45
Mpumalanga	22.9%	12.4%
Northern Cape	76.3%	43.3%
Limpopo	13.3%	4.9%
North West	30.5%	22.9%
Western Cape	82.4%	55.8%
National	**39.2%**	**26.5%**

While national statistics cite a remarkable improvement in access to computer technology tools in schools, teacher surveys show consistent declines in the use and integration of computer technology to enhance student learning (Keengwe et al., 2008; Wachira & Keengwe, 2010). Many practicing teachers face several challenges when trying to effectively integrate technology into their classroom instruction (Wachira & Keengwe, 2010). These challenges include a lack of ICT knowledge and experience. Teachers may lack knowledge in two ways: a lack of skills and expertise in using technology and a lack of pedagogical knowledge in using technology appropriately (Wachira & Keengwe, 2010). A study conducted by Wachira and Keengwe (2010) revealed that teachers did not have the ability to use technology to develop appropriate activities.

On the same note related literature emphasises a lack of ICT experience on the part of teachers. For example, Naicker (2011), in the descriptive statistics for the educators' level of computer usage, reveals that a mere 1.4% of the educators had no experience with computer technologies, while 6.3% of these educators had attempted to use computer technologies, but still required help on a regular basis. Only 15.1% of these educators were able to perform basic functions in a limited number of computer applications; and 49.6% of these educators could demonstrate a general competency in a number of computer applications. Only 23.6% of the educators had acquired the ability to competently use a broad spectrum of computer technologies; and finally 3.9% of these educators were extremely proficient in using a wide variety of computer technologies.

Due to a lack of trained personnel many schools have failed to achieve this objective. This is because teachers who are assigned to teach computer education in schools are not with the right option to teach (Majeed & Othman, 2012). In her survey "Using English language to teach ICT courses in Malaysian Secondary Schools, Majeed and Othman (2012) highlighted that teachers are aware of the importance of ICT and possess a good mastery of ICT skills, but their applications of ICT in school teaching are still at a low level. Literature by Buabeng-Andoh (2012) indicates that teachers' knowledge in basic ICT applications as well as integrating ICT into teaching and learning processes was low. Similarly, a study conducted by Wachira and Keengwe (2010) cited a lack of teacher training in appropriate technology use as a key reason for teachers' lack of knowledge in using technology. This study also indicated that the technology training had been generic and did not help teachers to learn content-specific ways of technology integration.

Based on these discussions, it is evident that the introduction of ICT in teaching and learning has not brought about any change in the delivery of education in schools. This implies that teachers have not shifted from teacher-centred instruction to student-centred learning.

4. The benefits of information and communication technology for education

ICTs have great potential for knowledge dissemination, effective learning, and the development of more efficient educational services (Buabeng-Andoh, 2012). In an EU Schoolnet (2010) survey on teachers' use of Acer netbooks,

a large number of participants believed that the use of netbooks had a positive impact on their learning, promoted individualised learning and helped to lengthen study beyond the school day. Although computer technology has a great potential to reform or even transform education, a study by Lim and Khine (2006) reported that educators believed that the mere use of computers in their lessons excited and motivated their students to learn. Moreover, the adoption of ICT by education has been seen as a powerful way to contribute to educational change, better prepare students for the information age, improve learning outcomes and competencies of learners, and equip students with survival skills for the information society.

Information and communication technology has not only changed the role of teachers in classrooms but has also provided them with a large number of software packages and websites that can be utilised for educational purposes. Rapid technological development is affording teachers new opportunities to test many more software packages and websites in their lessons (Demirci, 2009). PowerPoint, MS Word and Excel are among the most commonly used software packages in schools today and have pedagogical benefits.

Educational change is a slow process, and some educators require more time to gain experience with computers (Naicker, 2011). Educators are sensitive to change and if they do not see a change without any clearly recognised benefits, such as increased efficiency in administrative tasks and improvement in the learners' understanding of the subject, they will be hesitant to use computers in their teaching (Ward & Parr, 2010). Using technology obliges educators to adopt different teaching styles (Zhao & Cziko, 2001). Rather than viewing technology as merely a tool for delivery, it should be seen as a means to improve learning (Keengwe et al., 2008). Providing technology resources without effectively integrating them into instruction will not produce better learners (Tolmie, 2001). Unless simultaneous innovations occur in pedagogy, assessment, and other primary areas of education reform, technology by itself would not help improve education but instead continue to reinforce many educators' cynicism about fads based on magical machines (Dede, 2000).

5. Essential conditions for technology integration

For technology to have the desired impact on improved teaching and learning, essential conditions must be in place. When the International Society for Technology in Education (ISTE) established National Education Technology Standards (NETS) for teachers, students and administrators, they also described conditions that are necessary for teachers to exploit the potential power of technology. These conditions are discussed in the following section (ISTE, 2009; Roblyer, 2006):

Shared vision

Proactive leadership in developing a shared vision for educational technology among all education stakeholders, including teachers and support staff, school and district administrators, teacher educators, students, parents, and the community is necessary. Stakeholders at every level should be empowered to be leaders in effecting change. There must be a systemic plan aligned with a shared vision for school effectiveness and student learning through the infusion of ICT and digital learning resources. Ongoing funding to support technology infrastructure, personnel, digital resources, and staff development should also be planned for.

Equitable access

Robust and reliable access to current and emerging technologies and digital resources, with connectivity for all students, teachers, staff, and school leaders is a necessity.

Skilled personnel

Educators, support staff, and other leaders skilled in the selection and effective use of appropriate ICT resources remain an essential condition. Technology integration skills cannot be learned through passive observation − technology-related professional learning plans and opportunities need to be in place and dedicated time needs to be assigned to practising and sharing ideas.

5.1. Technical support

Consistent and reliable assistance for maintaining, renewing, and using ICT and digital learning resources is essential.

5.2. Curriculum framework

Content standards and related digital curriculum resources that are aligned with and support digital age learning and work are necessary in technology integration activities. Planning, teaching, and assessment need to be centered on the needs and abilities of students. Continuous assessment of teaching, learning, and leadership, and evaluation of the use of ICT and digital resources should be taken into consideration.

5.3. Engaged communities

There must be partnerships and collaboration within communities to support and fund the use of ICT and digital learning resources.

5.4. Support policies

These refer to policies, financial plans, accountability measures, and incentive structures to support the use of ICTs and other digital resources for learning and in district school operations. These include policies and initiatives at national, regional, and local levels to support schools and teacher preparation programmes in the effective implementation of technology so as to achieve curriculum and learning technology standards.

6. Methodology

This study adopts the qualitative methodological approach because the objective was not to generalise but to understand (Patton, 2002) the perceptions of teachers in the context of technology integration. A qualitative approach was followed in this research to explore areas about which little is known and to gain information about phenomena that are difficult to extract through more conventional research methods (Strauss & Corbin, 1998). The research was conducted in the form of a case study of senior secondary schools in Gauteng. A case study helps the researcher to learn more about little-known and poorly understood situations (Leedy & Ormrod, 2005).

Data collection methods used were interviews, observations and document reviews (McMillan & Schumacher, 2001). Semi-structured instruments were designed and used to generate data from two high school principals, two deputy principals and two education technology teachers of two core research sites (Bell, 1993). These participants were purposively selected to participate in the study based on their experience relating to the use of technology for teaching and learning (Cohen, Manion & Morrison, 2005; Maree, 2007). The focus was on a number of people who work together but have different roles, and the aim was to understand them as a group, with their different but interdependent functions and ways of thinking (Drever, 1995). These interviews were complemented by lesson observations and document reviews. Observations were negotiated with individual teachers and conducted once per subject lesson during normal teaching hours. The documents that were reviewed include the technology lessons, textbooks, learners' activities and records of learners' progress.

The selection of participants was informed by consent from the respondents, emphasising the voluntary nature of participation, addressing concerns regarding privacy, anonymity, confidentiality, and offering feedback to participants. Data was manually processed, and rigorously and systematically analysed based on empirical evidence gathered through interviews, observations and document reviews as suggested by Neuman (1998). To ensure trustworthiness, research protocols such as credibility, dependability and confirmability were followed.

7. Findings and discussions

The findings from the interviews, observations and document reviews revealed that teachers experience both the successes and challenges when integrating technology into the curriculum. These findings are discussed according to the given objectives of the study, namely to determine if teachers have access to technology equipments; to investigate if teachers are trained to use technology for teaching; and to find out if there are ICT policies to support the curriculum.

7.1. Access to technology equipment/resources

The findings regarding the availability of technology resources revealed that schools in the Gauteng province use Gauteng Online (GOL) as their technology resource. Participants in this study emphasised the availability and functionality of the GOL when stating the following:

"...Gauteng Online centers are available. From the District office side, training for educators and the GOL mobile bus are available. Gauteng Online labs are functional most of the times and there is twenty-four hours Internet connection for seven days in a week."

7.2 Policies to support the curriculum

The findings regarding the availability of technology policy revealed lack of uniformity in the implementation of ICT policy. One of the participants in this study explained:

"...uniformity of structures or procedures within the region is a major challenge. Schools do not know what is permissible and implementable due to the fact that e-Learning is a fairly new concept, it was introduced in 2007."

Based on this finding, effective technology integration that supports student learning requires school and district policies to ensure the appropriate behaviour, safety, and equitable treatment of all students (Roblyer 2006).

The findings related to support show that the Department of Education is taking some measures to support schools that are willing to integrate technology into their curriculum. Participants explained that as a means of support, there are guidance, monitoring and support systems from the e-Learning unit with regard to policy implementation. There are quarterly ICT coordinators' meetings at which all issues relating to technology are discussed. This finding is supported by Tondeur, Van Keer, Van Braak and Valeke (2007) who state that mechanisms need to be put in place to ensure that educators have adequate access to support. Tondeur et al. (2007) further emphasise the cooperation between schools as an important factor for the integration of ICT. In essence, successful ICT integration becomes much more likely when educators share the values expressed within the school policy and understand their implications. It is clear from this finding that central features underpinning the process of integration are contact with colleagues who share similar interests, interaction that involves knowledge exchange, and encouragement to take risks, combined with support in analysing why things go wrong and how they can be improved.

The other finding indicates the success of schools in negotiating and establishing partnerships with relevant sectors that would provide training and assist with maintenance problems. These partners include BMW, Telkom, MTN and Vodacom. It is evident that some of the schools in the province have already integrated technology into their teaching and learning activities. One of the participants involved in this study supported the notion of technology integration in schools and states the following:

"...there are collaboration groups whereby educators participate in the use of ICT in the classroom competitions and make presentations at conferences. There is also the use of Thutong portal by both learners and educators."

This finding is in line with Roblyer (2006) who explains that teachers need system-wide support to implement technology. This would mean that the school, district, local community, and the state share with teachers a commitment to using technology to support teaching and learning. Usually this commitment is documented in the form of a state-wide and or district-wide plan created as a cooperative effort to assist teachers, administrators, and community business partners.

7.3 Teacher training in using technology for teaching and learning

Despite the successes of technology integration, there are still challenges experienced by schools in integrating technology effectively into the teaching and learning activities. One of the challenges is a lack of teachers who are

qualified to integrate technology in teaching and learning in order to drive the technology 'wagon' and assist other teachers in integrating technology effectively into their teaching and learning activities. A lack of qualified teachers in the teaching of education technology was emphasised by participants interviewed in this study. They state:

"...we don't have manpower on the educator part. For example, there is only one person who was trained and also has an idea in relation to information technology (IT). These people are very scarce. There are people who have phobia of using computers. In a school like this, you would expect every educator to be having an e-mail address. There are many of the educators who still don't have e-mail addresses. These types of educators would only touch a computer whenever there is a demand of some kind, for example, if submission of marks is required."

This finding is in line with Roblyer's (2006) emphasis on teacher training. He explains that knowledgeable people are as important to a technology plan as up-to-date technology resources. According to Roblyer (2006), successful technology programs hinge on well-trained, motivated teachers. For this matter, educators must constantly read and attend conferences, workshops and meetings to keep up with leading-edge technology solutions.

Schools not only lack qualified education technology teachers, but there is also a need for a subject specialist in this field of education technology. To support this need, participants explain as follows:

"...we don't have a facilitator for Information Technology (IT) and Computer Applications Technology (CAT) in our district. Such people are scarce and we don't have even one around here. Our education technology teachers have to attend meetings in other districts."

In support of these findings, Roblyer (2006) suggests that each school have a technology liaison or coordinator to act as the school's representative in a district-wide planning committee.

Maintenance and technical problems are other challenges experienced by teachers when integrating technology into the curriculum. The findings from the interviews revealed that there were no qualified technicians on the school premises to solve the maintenance problems. One of the participants explained:

"...the problem we had then and that we continued to have for a number of years is maintenance. Every time we would have a computer breaking down, and it would take time for the technician who is already over burdened to come and fix that computer. So the learners could not continue. Learners will be held back while his friend in another workstation will be continuing. Sometimes computers will be out of action for a number of days depending on how serious the problem is."

To solve this problem, schools have to employ outside technicians who must travel from afar, which is costly for the schools. Maintenance and technical problems sometimes disrupt the smooth running of teaching and learning. From the observations, it was discovered that some of the computers were not functioning properly and some were not even connected to the internet. Roblyer (2006) maintains that setting up and maintaining physical facilities in schools can minimise technology repair problems if users follow good usage rules and conduct preventive maintenance procedures.

8. Conclusion

This study presents the findings from the interviews, observations and document studies. Although there is no clear-cut line between the successes and challenges experienced by teachers in integrating technology into teaching and learning activities, the findings of this study are summarised and discussed by grouping the questions for interviews into different topics. Generally, participants view teachers who are presently teaching education technology as being unqualified in terms of integrating technology into teaching and learning. Participants also highlighted this shortage of qualified teachers as negatively affecting the process of technology integration. For effective technology integration to take place, sufficient numbers of teachers need to be trained first, so as to equip the learners with the 21st century technology skills. Based on the literature as well as the findings of the study, it is recommended that teachers and technology education specialists be given sufficient training in the following areas: technology content knowledge, and maintenance and technical skills. In addition teacher professional development programmes should be continuously provided for teachers to update their technology knowledge and skills. In conclusion, literature indicated the availability of infrastructure in South Africa. This study therefore proposes

capacity building as a priority. If teachers are well equipped with technology knowledge and skills, they will be able to utilise the available technology tools.

References

Assan, T., & Thomas, R. (2012). Information and communication technology integration into teaching and learning: Opportunities and challenges for commerce educators in South Africa. *International Journal of Education and Development using Information and Communication Technology (IJEDICT),* 8(2), 4-16.

Bell, J. (1993). *Doing your research project: A guide for first-time researchers in education and social sciences.* Buckingham: Open University Press.

Buabeng-Andoh, C. (2012). An exploration of teachers' skills, perceptions and practices of ICT in teaching and learning in the Ghanaian second-cycle schools. *Contemporary Educational Technology*, 3(1), 36-49.

Cohen, L., Manion, L., & Morrison, K. (2005). *Research methods in education*. London: Routledge Falmer.

Dede, C. (2000). Rethinking how to invest in technology. In: Pea Roy D (Ed). *Technology and learning*. San Francisco, CA: Jossey-Bass.

Demirci, A. (2009). How do Teachers Approach New Technologies: Geography Teachers' Attitudes towards Geographic Information Systems (GIS). *European Journal of Educational Studies,* 1(1).

Department of Education (DoE). (2002). *Strategy for Information and Communication Technology in Education.* Pretoria: Department of Education.

Department of Education (DoE). (2003). *White Paper on e-Education. Transforming Learning and Teaching through Information and Communication Technologies*. Pretoria: Department of Education.

Drever, E. (1995). *Using semi-structured interviews in small-scale research*. Glasgow: SCRE.

EU Schoolnet. (2010). Summary: Netbook pre-pilot evaluation for teachers. Retrieved May 29, 2012 from http://www.eun.org/web.

Ginserb, R., & McCormick, V. (1998). Computer use in effective schools. *J Staff Dev* 19(1), 22-25.

International Society for Technology in Education (ISTE). (2009). National educational technology standards (NETS) for teachers. Retrieved March 29, 2012 from http://cnets.iste.org/teachers.

Keengwe, J., Onchwari, G., & Wachira, P. (2008). Computer technology integration and student learning: Barriers and promise. *J Sci Educ Technol*, 17, 560-565.

Koehler, M.J., & Mishra, P. (2005). What happens when teachers design educational technology? The development of technological pedagogical content knowledge. *J Educat Comput Res* 32(2), 131-152.

Law, N., Lee, Y., & Chow, A. (2002). Practice characteristics that lead to 21st century learning outcomes. *Journal of Computer Assisted Learning*, 18, 415-426.

Leedy, P.D., & Ormrod, J.E. (2005). *Practical research, planning and design*. New Jersey: Pearson.

Lim, C.P., & Khine, S.M. (2006). Managing teachers' barriers to ICT integration in Singapore schools. *J. Technol. Teach. Educ*, 14(1), 97-125.

Majeed, Z.S., & Othman, N. (2012). Using English language to teach ICT courses in selected Malaysian secondary schools. *International Journal of Academic Research in Business and Social Sciences,* May 2012, 2(5).

Maree, K. (2007). *First steps in research*. Pretoria: Van Schaik.

McMillan, J.H., & Schumacher, S. (2001). *Research in education: A conceptual introduction*. (5th ed.). New York: Longman.

Mehlinger, H.D., & Powers, S.M. (2002). *Technology and teacher education: A guide for educators and policymakers.* Boston: Houghton Mifflin.

Milone, M. (1999). Staff development: The inside story. *Technol LEARN* 20(3), 54-59.

Morgan, T. (1996). Using technology to enhance learning: Changing the chunks. *Learn Lead Technology* 23(5), 49-51.

Naicker, V. (2011). Educators' theories and beliefs and the use of computers in secondary schools. *Educational Research and Reviews,* 6(10), 688-694, 12 September, 2011.

National Centre for Education Statistics (NCES), U.S. Department of Education. (2000). Teacher use of the Internet in public schools. Retrieved May 29, 2012 from http://www.ascilite.org.au/ajet/ajet15/newhouse.html.

National Centre for Educational Statistics (NCES). (2007). *Internet access in US public schools and classrooms: 1994-2005*. Retrieved November 22, 2012 from http://nces.ed.gov/pubs2007/2007020.pdf.

Neuman, W.L. (1998). *Social research methods. Qualitative and quantitative approaches.* London: Allyn and Bacon.

Paraskeva, F., Bouta, H., & Papagianna, A. (2008). Individual characteristics and computer self-efficacy in secondary education teachers to integrate technology in educational practice. *Computers & Education*, 50(3), 1084-1091.

Patton, M.Q. (2002). *Qualitative evaluation and research methods.* Newbury Park, CA: Longman.

Ramorola, M.Z. (2010). *A study of effective technology integration into teaching and learning: A case study.* Pretoria: University of South Africa.

Roblyer, M.D. (2006). *Integrating educational technology into teaching.* (4th ed.). Upper Saddle River: Pearson.

Strauss, A., & Corbin, J. (1998). *Basics of qualitative research: Grounded theory procedures and techniques.* (2nd ed.). Thousand Oaks, CA: Sage.

T.H.E. Journal (1999). *Teachers of the 21st century know the what, why, and how of technological integration*. Retrieved March 23, 2012 from http://www.thehournal.com/magazine/vault/A2084.cfm.

Tolmie, A. (2001). Examining learning in relation to the contexts of use of ICT. *J Comput Assist Learn* 17, 235-241.doi:10.1046/j.0266-4909.2001.000178.x.

Tondeur, J., Van Keer, H., Van Braak, J., & Valeke, M. (2007). *ICT integration in the classroom: Challenging the potential of a school policy.* Ghent: Ghent University, Department of Educational Studies.

UNESCO and Commonwealth of Learning (COL). (2004). *Schoolnet Toolkit*. Bangkok: UNESCO; Vancouver: Commonwealth of Learning.

Wachira, P., & Keengwe, J. (2010). Technology integration barriers: Urban school mathematics teachers perspectives. *J Sci Educ Technol*, 20, 17-25.

Wang, Y. (2000). Preservice teachers' perceptions of the teachers' role in the classroom with computers. Society for information technology and teacher education international conference: Proceedings of SITE 2000. *Association for the Advancement of Computing in Education*. Charlottesville, VA.

Ward, L., & Parr, J. (2010). Revisiting and reframing use: Implications for the integration of ICT. *Comput. Educ.*, 54, 113-122.

Wilson-Strydom, M. & Thomson, J. (2005). *Understanding ICT integration in South African classrooms*. Retrieved November 27, 2012 from www.schoolnet.org/research/Wilson-Strydom_Thomson.doc.

Woodbridge, J. (2004). *Technology integration as a transforming teaching strategy*. Retrieved April 20, 2012 from http://www.techlearning.com/story/showArticle.php?articleID=17701367.

Zhao, Y., & Cziko, G.A. (2001). Teacher adoption of technology: A perceptional control theory perspective. *J. Technol. Teach. Educ.*, 9(1), 5-30.