



Revolutionizing Education through Information Communication Technology: Progress and Challenges in Rwanda

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ARTICLE INFO

Article No.: 031018038

Type: Research

DOI: 10.15580/GJER.2018.2.031018038

Submitted: 10/03/2018

Accepted: 25/03/2018

Published: 30/03/2018

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Keywords: Information Communication Technology, ICT Integration, ICT in education, Integration progress, Challenges, Rwanda.

ABSTRACT

This study examined the extent of educational transformation in Rwanda through ICT focusing on progress and challenges. Based on Activity Theory, the study used quantitative and qualitative research approaches. Recorded materials including official records and reports, public, private and personal documents, were analyzed to trace documentary information on the phenomenon under study. The findings show that programmes, projects, plans and policies to promote ICT infrastructure, hard and soft, in education were put in place. However, given the achievements registered in infrastructure, access, awareness and skills, this integration is still far from being at its fullest. Discrepancies in access, awareness and skills were registered between rural and urban areas, among levels of education and among different clusters of end users. Indeed, the ICT tool-end user ratio is still very high at all levels of education. It was recommended that enough funds be allocated to ICT infrastructure and literacy in an equitable way to allow equal chances of access and awareness for all education end users, that is urban as well as far-flung areas, women and men, young and old and all levels of education. Furthermore, the provision of ICT tools should be accompanied with adequate funds for maintenance and replacement. Government paid technicians should be availed to educational institutions. The government should also learn from the experiences of countries where ICT in education has succeeded remarkably.

1.0 INTRODUCTION

1.1 Background of the Study

Nowadays, it is largely felt by educationists that Information Communication Technologies (ICTs) constitute an overwhelmingly tool to transfigure education (Buabeng-Andoh, 2012; Unal & Ozturk, 2012; The 2AgePro Consortium, 2009). It is in this line of view that a paralleled wealth of literature shows that the large adoption of these technologies has swiftly revolutionized the education system in as well the Western World as in the Third World (Ampofo, Bizimana, Mbuthi, Ndayambaje, Ogeta & Orodho, 2014; Karsenti, Collin, & Harper-Merrett, 2012; Unal & Ozturk, 2012; The 2AgePro Consortium, 2009). By and large, the adoption of ICTs has become ever more indispensable for nations to develop economically and educate their citizens (Karsenti *et al.*, 2012).

Experience from round the world shows that nations highly rate the role of ICTs in educational changes. It is in this regard that Governments in the Organization of Economic Cooperation and Development (OECD) and Europe considerably value the concept of information society development, which has spread ICT adoption in general and particularly in education milieu and enhanced the development of ICT infrastructure, be it hard or soft, and ICT literacy programmes for the citizens have been put in place (The 2AgePro Consortium, 2009). What is more, The 2AgePro Consortium (2009) avers that initiatives for ICT infrastructure in schools, Broadband Connection, computer labs and computer and internet use in classes, ICT-based social communication tools for teachers like social sites, teacher enthusiasm to use ICTs during instruction delivery and enhanced means for repair along with support strategies have been put in place, which initiatives have enormously accelerated ICTs acquisition, usage, altered attitudes towards ICTs personally and institutionally.

The scenario is not too different on Asian continent. For instance, the Malaysian State considered integrating ICTs in its education system as means for instructional delivery and learning process. This was accompanied by the supply of ample ICT equipment in all education establishments and the revision of the Malaysian school curriculum to ensure a countrywide integration of ICTs. There has been a wide provision of ICT equipment like computers along with some most modern ICT devices such as Teaching/Learning Courseware (TLC) (Nasaruddin & Ismayatim, 2013). On American continent, Cuba considers technology as an important and it is used to support what schools have always done. Technological devices are used not only in the management of educational establishments but also in the teaching and learning process (Mumtaz, 2000).

In African context, Karsenti *et al.* (2012) and Farrell and Shafika (2007) disclose a pervasive

commitment to incorporate ICTs in education in this day and age. Studies and mechanism are currently well thought-out on how to disseminate the impact of ICTs in cultural, economic, social and educational contexts. Karsenti *et al.* (2012) also articulate that ICTs have enhanced positive changes like broadening access to higher education at a time when a great number of Higher Learning Institutions in Africa are still struggling under the burden of congested classrooms and laboratories. What is more, Open and Distance Learning which is enhanced by the currently proliferating ICTs serves in locally training qualified manpower, not having to go to the western world.

Although the above considerations and achievements, the pace at which the incorporation of ICT in education is moving remains far from being the same for all nations. Karsenti *et al.* (2012) and Tino (2002) noticed that the computers and the internet utilizations are not yet at their fullest in the Third World nations, if these technologies are used at all, because of inadequate infrastructure alongside related costs. Making reference to Karsenti *et al.* (2012) and Farrell and Shafia (2007), it is noticed also that though mechanism, policies and commitments to embrace ICTs in the education sector in almost all African countries, there are differences in terms of implementation progress.

What is more, Farrell and Shafia (2007) found that there are stratifications among African countries in terms of ability to implement, which makes it that South Africa and many of the Northern African countries have made tremendous achievements in the ICT infrastructure (soft and hard) like enjoyed in European countries while another stratum comprises the nations with steady movement towards the economic stabilization like Cameroon, Ghana, Mauritius, and Botswana which view ICT as an assistive means to accelerate the socio-economic development. Another group, substantially large, is made of those countries that are moving from the periods of conflicts and authoritarianism. At the same time, there are a lot of other countries that remain snowed under the conflicts and political turmoil, for which the progress of ICT in education remains elusive. For this reason, a study of this kind was deemed important in the context of Rwanda, a post genocide country, to examine the extent to which Education is being revolutionized by means of ICT tools with focus to commitments and challenges.

1.2.0 State of art review

1.2.1. Understanding ICTs, common educational ICT tools and their impact

The contraction ICTs stands for Information and Communication Technologies, so termed to name technological devices for creation, communication, dissemination, storage, and management of information (Ampofo *et al.*, 2014; Tinio, 2002), like computer,

Internet, information diffusion tools (radio and television) as well as telephony (Tinio, 2002). Even if education is currently experiencing an upsurge of interest in new technologies such as computers and Internet to advance efficient and effective processes at all levels and settings (Unal & Ozturk, 2012, Tinio, 2002), ICT tools are more than these technologies. There exist a number of older technologies like the telephone, radio and television with a long and rich history as instructional tools though a nowadays limited consideration. For instance, radio and television have been used in Open and Distance Learning for more than forty years and the print media continues to be used in instruction delivery in as well developed as developing countries (Tinio, 2002).

What is more, dissimilar technologies are used in a blended way instead of using a certain type solely (Baek, Jung & Kim, 2006; Tonio, 2002). Rightly turning to Tonio (2002), it is noted for instance how Kothmale Community Radio at the same time resorts to radio broadcasts, computer alongside Internet technologies for the smooth progress of information sharing and the provision of educational opportunities to remote area communities of Sri Lanka. Similarly, Tonio (2002) goes on to say, the Open University of the United Kingdom (UKOU) continues to rely heavily on hard printed equipment complimented with radio, television and e-programmes. Likewise, the Indira Gandhi National Open University coalesces printed, recorded audiovisual materials, radio and television broadcasts and audio-conferencing technology.

Expanding in this way, ICTs have brought about a lot of enthusiasm in education. For example ICTs have brought in new teaching techniques (Unal & Ozturk, 2012), exhibited the potential to aid educationists, teachers and learners to reach a great range of accessible instructional materials using one instrument which is the computer connected to Internet, easiness of Open and Distance Learning (ODL) and e-learning therefore providing an effective way out of the problems of lack of instructors to deliver face-to-face courses or insufficiency of classrooms and labs (Ampofo *et al.*, 2014; Karsenti *et al.*, 2012; Unal & Ozturk, 2012), a move from teacher-centeredness to learner-centeredness way of teaching (Karsenti *et al.*, 2012) and a means to promote equal opportunities to all learners where for instance visually impaired learners are catered for using assistive technologies (Bocconi, Dini, Ferlino, Martinoli & Ott, n.d). Additionally, the widespread adoption of ICTs is viewed as a tool to enable education system to produce the manpower proficient enough to respond to the new needs on the labor market and increasingly volatile environment (Ndayambaje & Orodho, 2014).

Aside, Gutterman, Rahman, Supelano, Thies and Yang (2009); Ndayambaje and Orodho (2014), and Tinio (2002) contend that integration of ICTs have transfigured education in such a way that electronic learning including web-based learning, computer-based learning, virtual classrooms, and digital collaboration, in which contents are distributed by means of the Internet

and or Intranet or Extranet, audio and or video tape, satellite TV and CD-ROM has tremendously progressed. Gutterman *et al.* (2009) adds that ICTs have so far their big share in increasing education and better quality in education where for instance the teaching-learning process is directly and positively affected by ICT utilization.

1.2.2 Process of ICT integration in the teaching and learning process

The success of ICT integration in education, specifically in the teaching and learning process does not derive from or without. The players of teaching and learning activities, teacher and student, should be prepared in different ways to embrace the advent of ICTs in the process (Aktaruzzaman, Shamim & Clement, 2011). ICT integration in teaching and learning should commence with the preparation of the instructor on basic computer and technological operations and concepts. This involves training teachers on how to process data on the computer and release data and carry out some troubleshooting in when need be. At this level, students are to act as planned and organized by their instructor. In other words, what learners do should be influenced by instructor's activities (Kyalo & Nzuki, 2014; Aktaruzzaman *et al.*, 2011). At this level, the need for pertinent personnel who technically supports the process emerges, which builds on the principle that for positive and effective ICT integration, professional development by means of training is necessary to link the technologically driven changes (Kyalo & Nzuki, 2014).

For instructors to use ICTs effectively they should first apply them on they own for their skill expansion and output personally and professionally. In other words, classroom integration of ICTs should not be the instructor's first attempt to utilize ICTs. While the instructor gets this pre-integration training, the learners should be trained on the modes of teacher-learner interaction using ICTs and the mode of presenting their own content to the teacher like presentation-telling and or showing and doing (Aktaruzzaman *et al.*, 2011). The next step is therefore the application of ICTs in the teaching and learning process. At this level, the computer use is associated with the related technological devices that are supportive to the learners considering their grade level and the subject to be taught or learned and the heterogeneity among the learners (Aktaruzzaman *et al.*, 2011).

1.3 Statement of the problem

In the year 2000 the Government of Rwanda pledged to integrate ICT in education not only as source of knowledge but also as a means to facilitate access to cheaper, faster and an up-to-date system of education and transform Rwandans into a knowledge-based society by the year 2020 (Ampofo *et al.*, 2014). Fifteen years later and five years to the pledged fullest integration, while ICTs would be expected to be fully at

the heart of teaching and learning in Rwanda, the One Laptop Per Child (OLPC) programme that was meant to reach all primary school going Rwandan children to instill ICT desire and knowledge was abandoned due to many reported shortcomings (Gasore, 2015). It is also reported that a number of computers in schools are non-operational alongside a considerable unused hardware in schools (Nicholas International Education Partners Ltd, 2014). Hence, one would wonder how the education sector in Rwanda is in line with other sectors to make Rwanda an ICT driven nation.

1.4 Research objectives

1. To explore the ICT incorporation progress in education system in Rwanda.
2. Analyze the challenges to ICT integration process in Rwanda system of education and suggest remedial solutions.

1.5 Theoretical perspective

The present study was guided by the theory known as Activity Theory that originates from Vigotsky, Leont'ev and Luria in the 20th century (Kaptelinin & Nardi, 2012). The Activity Theory stipulates that humans use technical artefacts like instruments to realize predefined goals (Kofod-Petersen & Cassens, n.d) and it is used to explain the mediation of humans to the environment by tools such as ICTs (Murphy & Rodriguez-Manzanares, 2008). In actual facts, this theory best fits to this study because it has been relied on for a long time to channel studies in Education Technology (Murphy & Rodriguez-Manzanares, 2008) and investigate humans' activities in specific social settings such as work or learning (Parks, 2000) in Murphy & Rodriguez-Manzanares (2008). What is more, in the education milieu, Activity Theory is positioned as of a paramount importance in analyzing activities of an organization which involve computer utilization. Activity Theory facilitates the consideration of how technological advances influence change in the academic area (Kaptelinin & Nardi, 2012; Murphy & Rodriguez-Manzanares, 2008; Kuutti, 2008).

2. METHODOLOGY

This study embraced quantitative and qualitative approaches (Tichapondwa, 2013; Creswell, Klassen, Clark & Smith, 2010; Orodho, 2017; Orodho, Nzabalirwa, Odundo, Waweru & Ndayambaje, 2016) and documentary research methods (Mogalakwe, 2006). In this respect, the researcher reviewed and analyzed mechanically recorded materials including official records and reports, public, private and personal documents to trace documentary information on the phenomenon under study (Tichapondwa, 2013; Creswell *et al.* 2010; Orodho, 2017; Mogalakwe, 2006), that is, in the present case ICT integration progress, commitments and challenges to ICT integration in education system in

Rwanda. A state of art review on the concept of ICT, ICT tools commonly used in education and their impact to educational system and the process of ICT integration in the teaching and learning was carried out. The computer and the Internet were the ICT tools focused on in this study.

3.0 FINDINGS AND DISCUSSION

3.1 The country progress in ICT integration in education

While Rwanda has emerged from tragic period of genocide and prolonged conflict and is still a low-income country, it has shown a very proactive commitment to the promoting of ICT in its educational system centered on ICT infrastructure (hard and soft) and ICT literacy (InfoDev, 2013; EdQual, 2010; Gutterman, 2009). Apart from its own efforts, the Government of Rwanda (GoR) in collaboration with private donors willing to invest in ICT programmes in education has received noteworthy support which will provide opportunities enabling a wider population spectrum to reach ICT. The commitment is not only to instill ICT in administration of education system, but also to promote e-education (Gutterman, 2009).

InfoDev (2013) also points out that the Government of Rwanda embedded the National Information and Communication Infrastructure (NICI) plans in its Vision 2020. The four plans, each of which extending to five years from the year 2020, are meant to guide, reform and accelerate ICT infrastructure. The targets of the NICI include not only the expansion of ICT infrastructure, hard and soft, but also the promotion of ICT literacy in different sectors including education.

Reference made to InfoDev (2013), Republic of Rwanda, Ministry of Youth and ICT (2012) and Gutterman (2009) is of evidence that Rwanda has implemented a five-year plan One Laptop Per Child (OLPC) in primary schools. This programme aims at promoting children's ownership of education built on ICT; children's desire of ICT; early children's exposure to ICT, that is between 6-12 years of age, and Internet connection that expose the children to the outside world. Gutterman (2009) adds that in collaboration with ESRI, Germany has granted Geographical Information System Software (GIS) to all education institutions together with the provision of professionals whose role is to bring GIS to learners and instructors.

InfoDev (2013) and Republic of Rwanda, Ministry of Youth and ICT (2012) mention that the GIS plays a big role in ICT literacy using the Snowball diffusion replica by means of which education institutions coach other education institutions and support one another. A number of teachers is receiving trainings for computer literacy to enable them use their laptops and be able to help children use the laptops given out in the OLPC programme. The Rwandan Regional ICT Training Centre (RITC) was created to offer these trainings in

order to build confidence in teachers to integrate ICT in their classrooms.

Because of an instilled desire to use ICTs, write Guttermann (2009), a lot of juvenile learners use ICT after school and this also positively impacts on ICT in education. For instance, some mainly access Internet cafés which impacts on learning in schools while others

resort to ICT devices available in the communities. The young learners' ends of using Internet outside school include search for information needed to handle their schoolwork. Republic of Rwanda, Ministry of Youth and ICT (2012) shows progress made in ICT tools, hard and soft, distribution at all levels in Rwanda system of education as per table 1:

Table 1: ICT in Education in Rwanda

Key indicator/Sector	Year (2012)
Primary level	Figures
Computers for instructors	2294
Computer to instructor ratio	1:18
Computers for learners	60,301
Computer to pupil ratio	1:40
Education establishments with computers	1,019 (39.28%)
Number of OLPC laptops given out	152,768
Education establishments covered by OLPC programme	292 (11.17%)
Education establishments with Internet connectivity	160 (6.17%)
Education establishments with a networked computer lab	81 (3.12%)
Secondary level	
Computers for instructors	3,532
Computer to instructor ratio	1:6
Computers for learners	13,468
Computer to learner ratio	1:40
Education establishments with computers	933 (63.64%)
Education establishments with Internet connectivity	271 (18.48%)
Education establishments with a networked computer lab	361 (24.62%)
Higher education	
Computers for administrative staff	1,080
Computer to administrative staff ratio	1:2
Computers for academic staff	825
Computer to academic staff ratio	1:4
Computers for students	3,984
Computer to student ratio	1:19
Higher learning establishments with internet connectivity	31 (100%)
Higher learning establishments with a networked computer lab	31 (100%)
Total number of e-Journals available	33,000
Open, Distance and eLearning (ODEL)	
Total number of institutions offering ODeL	N/Av
Total number of ODeL students:	3,166
Male	2,036 (64.30%)
Female	1,130 (35.70%)
ICT skill development	
Higher Learning Institutions that offer ICT-related programmes	13 (41.9%)
TVET students doing ICT-related programmes (in country and abroad):	7,959
Male	4,001 (50.27%)
Female	3,955 (49.73%)
Undergraduate students doing in ICT-related programmes (in country and abroad):	N/Av.

Source: Republic of Rwanda, Ministry of Youth and ICT (2017).

The statistics in Table 1 show that there was a persistent high computer to end users' ratio whereby in primary level of education 18 instructors shared one computer while 40 learners used one computer. Primary education

establishments that had computer infrastructure were far below those which did not have (39.28%). Primary education establishments covered by OLPC programmes, with Internet connectivity and networked

computer laboratories were respectively 11.17%, 6.17% and 3.12%, which is very far below those that did not have them. Noticeably, the OLPC programme that was recently abandoned (Gasore, 2015) was still at its embryonic stage considering that scanty number of schools it reached since it was introduced in 2008.

At secondary level, the scenario is not too different. Figures show that six instructors shared one computer (1:6) whereas forty students shared one computer. It goes without saying that this computer end users ratio is high. What is more, only 63.64% schools had computers, 18.48% schools had Internet connectivity while 24.62% only had networked computer laboratory.

At higher learning level, computer to end user ratio seemed to lower compared to primary and secondary levels (one computer to two administrative

staff and one computer to four academic staff) whilst one computer was shared by nineteen students. At least at higher level, all institutions (100%) had internet connectivity and a networked computer laboratory. In terms of Open Distance and e-learning as modes of study through ICTs among the enrolled students (3166), men surpassed women (2036 (64.30%) against 1130 (35.70%).

With regards to ICT skill development, out of students doing ICT-related programmes (7559), 4001 (50.27%) were men whereas 3955 (49.73%) were women. Only 13 out of 31 (41.9%) institutions of higher learning provided ICT-related programmes. The significance of differences among levels of education and between men and women in terms of ICT infrastructure and awareness is portrayed in the table 2:

Table 2: ANOVA F-Test for the test of differences among levels of education and between men and women in terms of ICT infrastructure and awareness

Variables	F/	Sig.
Computers per level of education	.617	.576
ICT awareness between men and women	.077	.808

Table 2 shows that there is a statistically significant difference among levels of education in terms of ICT infrastructure availability since the F-test is significant ($p\text{-value} = .576 > .05$). There is also a significant difference between men and women in terms of ICT awareness. F-test is significant ($p\text{-value} = .808 > .05$).

3.2 Challenges to ICT Integration in education in Rwanda

In Rwandan traditional saying, it is said that *“when you want to cure of the illness you are suffering from, you talk about”*. In this respect, it should not go without saying that though the progress made in ICT infrastructure, awareness and literacy, certain challenges which prevent the ICT embedding to be at its fullest are to be registered.

The statistics show that infrastructure, both hard and soft, is still low in relation to the number of end users (Nicholas International Education Partners Ltd, 2014; Republic of Rwanda-Ministry of Youth and ICT, 2012). A gap in terms of ICT access, awareness and literacy still persist between urban and rural areas and between males and female end users and between levels of education with rural and female ones being the most disadvantaged (Nicholas International Education Partners Ltd, 2014). In line with data record in table 1, EdQual (2010) notes that access to ICT infrastructure in secondary schools outweighs that of primary schools. There is also a gap in access to other required infrastructure, like electricity, for ICT tools to run (Nicholas International Education Partners Ltd, 2014; InfoDev, 2013; Republic of Rwanda, Ministry of Youth and ICT, 2012; EdQual, 2010; Gutterman, 2009). A gap

is also observed between the capital city, Kigali, and the rest of the country. Nicholas International Education Partners Ltd (2014) and EdQual, (2010) noticed that Kigali city is the most advantaged in terms of ICT infrastructure and electricity in schools.

Nicholas International Education Partners Ltd (2014) and Gutterman (2009) notices that there is still insufficiency of teachers and those available need training in the maintenance of computers in cases of break down. Rwanda is not yet potentially to recruit and retain ICT instructors. According Nicholas International Education Partners Ltd (2014) and EdQual (2010), this has resulted in the presence of many out of function computers within education institution and a lot of expenses of maintenance and or restricted utilization of available computers. The Ministry of education supplies computers without the provision of additional funds for maintenance, which requires huge payments to private technicians for repair. This situation worsens when it comes to rural schools that have to bring those technicians from the towns. The alternative is therefore to restrict students' access to these computers and they merely access computer labs in the presence of an instructor who oversees them.

4.0 CONCLUSION AND RECOMMENDATIONS

4.1 Conclusions and Implications

The driving motives to conduct this study were to explore the ICT incorporation progress and analyze the challenges to ICT integration process in Rwanda system of education and suggest remedial solutions. It was

concluded that, through different programmes, projects and plans, the Government of Rwanda is committed to revolutionize its system of education through ICT integration in education in order to boost its quality and enjoy different benefits of CT tools in education. However, given the achievements registered in infrastructure, access, awareness and skills, this integration is still far from being at its fullest. Discrepancies were registered between rural and urban areas, between levels of education and among different clusters of end users. The implication of this is that if the situation remains unchanged, it may create a bottleneck to the country's endeavour to promote ICT literacy in different sectors including education.

4.2 Recommendations

Based on the finding on the progress and challenges of ICT integration in Rwanda, the researcher recommends the following:

1. The government of Rwanda in collaboration with any concerned stakeholders should allocate enough budgets to boost the expansion of ICT infrastructure, soft and hard, and ICT literacy in an equitable way to allow equal chances of access and awareness for all end users, that is urban as well as far-flung areas, women and men, young and old and all levels of education.
2. The provision of ICT tools should be accompanied with adequate funds for maintenance and replacement and or availability of government paid technicians to institutions.
3. The Government of Rwanda should allocate sufficient budgets for teachers and students' trainings in ICT while the NICI should expand its training centers to all corners of the country.
4. The Government should instill the desire for all categories of end users to embrace ICT specifically focusing on girls, women and the old not only in Kigali city but also in all areas of the country.
5. The Government of Rwanda should learn from the experiences from the countries where ICT integration in education has succeeded like South Africa, Northern Africa and The European Union. This could in time allow Rwanda to learn how these countries handled the challenges they might have had in ICT implementation.
6. As this study was winding some questions left unanswered, which need further studies. Further research could for instance be carried out on how the new information technologies, that is the Computer and the Internet, could be supported by old technologies like the Radio, Television and the Telephony to promote efficiency and effectiveness of education institutions.

REFERENCES

- Aktaruzzaman, Shamim, H. R. & Clement, K. C. (2011). Trends and Issues to integrate ICT in Teaching Learning for the Future World of Education. *International Journal of Engineering & Technology IJET-IJENS*, 11 (03), pp. 114-119.
- Ampofo, Y. S., Bizimana, B., Mbuti, J., Ndayambaje, I. Ogeta, O. & Orodho, A. J. (2014). Information Communication Technology Penetration and its Impact on Education: Lessons of Experience from Selected African Countries of Ghana, Kenya and Rwanda. *Journal of Information Engineering and Applications*, 4(11), pp. 225-256.
- Baek, Y., Jung, J. & Kim, B. (2006). What Makes Teachers Use Technology in the Classroom? Exploring the Factors Affecting Facilitation of Technology with a Korean Sample. *Computers & Education*, pp. 224-234. From: www.elsevier.com/locate/compedu.
- Bocconi, S., Dini, S., Ferlino, L., Martinoli, C. & Ott, M. (n.d). *ICT Educational Tools and Visually Impaired Students: Different Answers to Different Accessibility Needs*. Genoa: Institute for Educational Technology-National Council of Research.
- Buabeng-Andoh, C. (2012). Factors Influencing Teachers' Adoption and Integration of Information and Communication Technology into Teaching: A Review of the Literature. *International Journal of Education and Development using Information and Communication Technology (IJEDICT)*, 8 (1), pp.136-155.
- Creswell, J. W., Klassen, A. C., Clark, V. L. P. & Smith, L. C. (2010). *Best Practices for Mixed Methods Research in the Health Sciences*. OBSSR.
- Farrell, G. & Shafika, S. (2007). *Survey of ICT and Education in Africa: A Summary Report, Based on 53 Country Surveys*. Washington, DC: info Dev / World Bank. Available at <http://www.infodev.org/en/Publication.353.html>.
- Fjeld, M., Lauche, K., Bichsel, M., Voorhorst, F., M., Krueger, H. & Rauterberg, M. (2002). "Physical and Virtual Tools: Activity Theory Applied to the Design of Groupware". *Computer Supported Cooperative Work* 11, pp. 153-180.
- Gasore, B. (2015, March 27). Government moves to transform One Laptop Programme. *The New Times*. From: <http://www.newtimes.co.rw/section/article/2015-03-27/187315/>.
- Guterman, B., Rahman, S., Supelano, J., Thies, L. & Yang, M. (2009). *Information & Communication Technologies (ICT) in Education for Development*. New York: GLID.
- Info Dev. (2013). *Towards Transformation? ICT in Post-conflict Rwanda*. Washington: International Bank for Reconstruction and Development/The World Bank. From: <http://www.infodev.org/en/Publication.1195.html>.

- Kaptelini, N. V. & Nardi, B. (2012). *Activity Theory in HCI: Fundamentals and Reflection*. New York: Morgan & Claypool Publishers Series. From: www.morganclaypool.com.
- Karsenti, T., Collin, S. & Harper-Merrett, T. (2012). *Pedagogical Integration of ICT: Successes and Challenges from 100+ African Schools*. Ottawa: IDRC.
- Kofod-Petersen, A. & Cassens, J. (n.d). *Using Activity Theory to Model Context Awareness*. From: <http://www.idi.ntnu.no/>.
- Kuutti, K.(2008). *Activity Theory as a Potential Framework for Human-Computer Interaction Research*. From: <http://www.idi.ntnu.no/>.
- Kyalo, K. J. & Nzuki, M. D. (2014). Determinants of Information and Communication Technology (ICT) Integration in Tertiary Institutions. *International Journal of Education and Research*, 2 (3), 10p.
- Mogalakwe, M. (2006). The Use of Documentary Research Methods in Social Research. *African Sociological Review*, 10 (1), pp. 221-230.
- Mumtaz, S. (2000). Factors Affecting Teachers' Use of Information and Communications Technology: a Review of the Literature. *Journal of Information Technology for Teacher Education*, 9 (3), 16p.
- Murphy, E. & Rodriguez-Manzanares, M. A. (2008). Using Activity Theory and Its Principle of Contradictions to Guide Research in Educational Technology. *Australasian Journal of Educational Technology*, 24(4), pp. 442-457.
- Nasaruddin, F. H & Ismayatim. W. F. (2013). Factors Affecting the Usage of Multimedia Teaching Tools by Schoolteachers. *4th International Conference on Computer Science and Information Technology (ICCSIT'2013) Oct. 6-7, Dubai (UAE)*.
- Ndayambaje & Orodho (2014). Provision and Usage of Computer and Internet Facilities at the College of Education of the University of Rwanda. *IOSR Journal of Humanities and Social Science (IOSR-JHSS)*, 9 (3) pp. 13-20.
- Nicholas International Education Partners Ltd. (2014). *Total Cost of Ownership: Contract Completion Report*. Kigali: Department for International Development (DFID) of the UK Government, for the Government of Rwanda.
- Orodho, J. A. (2017). *Elements of Education and Social Science Research Methods* (2nd Ed.). Nairobi: Kanezja Publishers.
- Orodho, J. A., Nzabaliwa, W., Oundo, P., Waweru, P. N. & Ndayambaje, I. (2016). *Quantitative and Qualitative Research: A Step by Step Guide to Scholarly Excellence*. Nairobi: Kanezja Publishers.
- Parks, S. (2000). Same task, Different Activities: Issues of Investment, Identity and Use of Strategy. *TESL Canada Journal*, 17(2), pp. 64-88.
- Republic of Rwanda, Ministry of Youth and ICT.(2011). *National ICT Strategy and Plan-NICI-2015*. Kigali: Republic of Rwanda, Office of the President.
- Republic of Rwanda, Ministry of Youth and ICT. (2017). *Rwanda ICT Sector Profile – 2012: Measuring ICT Sector Performance and Tracking ICT for Development (ICT4D) towards Rwanda Socio-Economic Transformation*. Kigali: Ministry of Youth and ICT.
- The 2AgePro Consortium. (2009). *Common ICT tools Used in Teachers' Daily Work: Current State Description*. Oulu: University of Oulu-Learning and Research Services.
- Tachapondwa, S. M. (Ed.) (2013). *Preparing your Dissertation at a Distance: A Research Guide*. Vancouver: Virtual University For Small States of the Collon wealth.
- Tinio V. L. (2002). *ICT in Education*. From: <http://www.eprimers.org> and <http://www.apdip.net>.
- Unal, S. & Ozturk, I. H. (2012). Barriers to ITC Integration into Teachers' Classroom Practices: Lessons from a Case Study on Social Studies Teachers in Turkey. *World Applied Sciences Journal* 18 (7), pp. 939-944.