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Enhancing quality of teaching and learning sciences through multimedia in selected secondary schools in Rwanda

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Abstract

The main purpose of this article is to highlight the role of multimedia in improving the quality of teaching and learning sciences in selected secondary schools in Rwanda. Specifically, it explores importance of using multimedia in teaching and learning sciences, extent to which science teachers use multimedia, impact of multimedia on students' performance, and challenges encountered in using multimedia. The Cognitive Constructivist Theory of Multimedia (CCTM) guided this paper and it adopted the Static-Group Pretest-Posttest Research design whereby two existing classrooms were used: one as treatment group and another one as control group. 40 teachers randomly selected were involved in this research and data were gathered through document review guide, questionnaire as well as a test. The analysis of qualitative data was done thematically and percentages, means, standard deviation and t-test were used for quantitative data. Findings were presented in tables and verbatim. The paper noted that multimedia is poorly provided and teachers rarely use them in teaching. It further noted that multimedia has a significant impact on students' performance. The paper recommended to provide more multimedia and use them for effective teaching and learning of sciences.

Key words: *Quality; teaching, science; multimedia; ICT; Rwanda*

Introduction

As the World Bank and UNESCO have declared, quality of education continues to decline in the developing countries whereby children are failing to acquire the basic numeracy and literacy skills (World Bank, 2018, UNESCO, 2014). As it is in many other developing countries, quality of education in Rwanda is also a major concern. To deal with the issue of quality education, the government and its educational stakeholders adopted a number of measures. To this end, as it is stated in its vision 2020, the government of Rwanda committed itself to promote science and technology in order to boost national economic development by mainstreaming the integration of technology such as multimedia tools in education system (GoR, 2001). It is in this perspective that since 2008 the Rwandan Ministry of Education has implemented the 'One Laptop per Child' (OLPC) program with the purpose of providing every primary school pupil with a laptop and equipping secondary schools with computer labs. Until 2016, 10% and 5% of all primary and secondary schools benefited from the program respectively and the policy has been revised to a "One Digital Identity Per Child and Smart Classrooms" in all primary and secondary schools (MINEDUC, 20016).

The importance of ICTs and how they change the world dominates contemporary literature. For instance, Daniels (2002) asserts that ICTs constitutes a basic building block of the modern society. It did not take long time to happen. It is in this regard that there is a rapid growth of multimedia within the education sector. According to Aloraini (2012) multimedia consists of the integration of texts and illustration such as color, graphical images, animation in single application. He adds that the integration of all these elements in education enhances learning by involving students in learning by doing situation. Similarly, Hadmin (2000) states that the combination of texts, spoken works, sounds and other illustrations in one presentation leads to successful teaching, that promotes learners' interests in return.



The reason behind mainstreaming multimedia technologies in education system is to solve the big number of problems that education is facing. According to Aloraini (2012) education system is failing to be productive due to over-population, lack of staff, and insufficient instructional materials among many others. For him, mainstreaming technology especially multimedia technology within education system is the best solution to improve educational productivity. In the same vein, the Rwandan Ministry of Education emphasizes that integration of ICT in education lead to expansion of access to education, quality of education and training and relevance of education to the current labor market (MINEDUC, 2016).

Likewise, Multimedia uses drill and practice which helps students to master basic skills. Because multimedia uses learning by doing, it helps learners to develop competences of problem solving. It enables understanding abstracts concepts. Moreover, multimedia enables teachers and students in inaccessible areas to access learning resources and content. It facilitates learner centered teaching by promoting both individual and cooperative learning. It supports in administration and management of classroom learning tasks and content. It simulates real life problem management environment (Malik and Agarwal, 2012).

Different educationists, researchers, and policy makers have presented the use of multimedia in education as the best technique to boost the quality of education. To this end, Nonofu (2006) states that institutions of learning can empower their students by using multimedia-based teaching because multimedia are aligned with the realities of the world. Similarly, Zaitoun (2002) confirms that unlike the written presentations of texts presented in the book, multimedia methods make the process of reading a process which is dynamic. In the same vein, Aloraini (2005) adds that the presentation of different visual materials and illustrations clarify the ideas and communication. He further adds that using different audiovisual materials such as video clips associated with other teaching and learning materials provides information which are close to the real thing. When music is added to the presentation it becomes more attractive and therefore, it is more likely to attract the attention and curiosity of the learners.

Qandeel (1998) emphasizes that multimedia increases the attention of students and raise their participation in their learning process. This would result into students' interaction with content they have to cover and learning becomes a fun as because it is done through amusement and suspense. This was supported by Holsinger (1995) who confirmed that multimedia enables both teachers and learners to deal with teaching subjects with broader sense as different subjects comprise enormous information, consequently encouraging curiosity to dig deeper. To complement this Alfar (2009) confirms that multimedia approaches encourage peer learning among learners, hence facilitate learners to remember and apply their knowledge in different contexts.

Multimedia provides a conducive environment for learning in which learners acquire basic skills for problem solving, master fundamental skills through learning by doing, and understand abstract concepts. It also initiates students to dealing with problem handling encountered in real life environments (Malik and Agarwal, 2012). For instance, using experimental methods, Sterling and Gray (1991) conducted experimental research to find out the relationship between computer simulations and the students' tendencies as well as their answers to statistical course. The work revealed that the group which received treatment performed better than the group which did not. Likewise, Beichner (1994) found that there is positive effect on emotions and knowledge of science of students when taught using multimedia. Furthermore, Ameen (1995) led an experimental study to explore how hyper-media affect university students' academic achievement and their attitudes toward computer. The study discovered that after treatment, the performance of experimental group was better than the performance of the control group. Hence there was a statistically important variance both in computer attitude scale and academic achievement between experimental and control groups. This was confirmed by Callaway (1997) who studied the effect of multimedia use in the process of learning and teaching on the performance of students and found that there is better performance of students who were taught using multimedia approach than their counterparts taught in traditional way.

In the same vein, Allen (1998) did a quasi-experimental study to explore how multimedia software affect the performance of students, their capacity to retain knowledge and their attitudes to computer. The findings this research revealed that multimedia software are effective in raising students' academic achievement, increasing their retention of acquired knowledge and changing their attitude toward computer. Ghazzawi (2002) conducted out a study to investigate effect of computerized methods involving movement on students' performance and the findings



revealed that there is a significant difference on the side of computerized method involving motion stimuli because of movement factor. Likewise, Majid (2002) carried experimental research to find out the consequence of a given program that uses heightened multimedia together with computer to teach analytical geometry on the acquisition of knowledge and evolving the divergent thinking as well as decision-taking capacity among students of secondary school. The finding of this study revealed an alteration in the performance of experimental and control groups putting the former in good position in the three tests.

In the research carried out by Nadar (2003) to investigate the efficacy of using computer in teaching students how to effectively use video camera, the results revealed that computer is an effective tool in development necessary basic skills for usage of video camera. In the same vein, Ibrahim (2003) did research whose the purpose was to use multimedia technology to teach the subject of computer basics in such a way that results in accessibility of appropriated skills and knowledge in relation to computer domain. The findings of the research revealed that multimedia technology is effective in imparting in students' appropriate knowledge and skills correlated to the computer domain.

On the other side, Da'lij (2008) did experimental research to detect the effect of applying locally produced multimedia software on students' academic performance in mathematics. This study revealed that there were similarities between the group taught using local multimedia and the group that was not taught using the locally produced multimedia. Conversely, in the study done by Nasr (2005) to examine efficacy of multimedia computer technology to teach geometry on the academic achievement of students and their ability to develop innovative thinking, it was found that there are statistically significant differences between the performance of treatment group and that of control group. The program was built on interactive multimedia technology which favored the experimental group. Despite the contribution of multimedia, it was realized that in Rwanda multimedia tools are given little consideration in many educational settings and they are rarely used for teaching purposes (Mineduc, 2013). To this end, using Cognitive-Constructivist Theory of Multimedia (CCTM), this study sought to sightsee the key role of using multimedia to improve learning and teaching sciences in selected secondary schools in Rwanda. The ability to do so would help educational stakeholders create a conducive learning environment through the use of multimedia technologies. Specifically, the study sought to achieve the following objectives:

- To find out the level at which multimedia tools are provided in selected secondary schools
- To identify the degree to which multimedia are used by teachers in selected secondary schools
- To determine the impact of multimedia on students' performance in selected secondary schools
- To identify the challenges that teachers encounter when using multimedia.

Research methodology

The present study adopted the static-group pretest-posttest research design which is a sub-design of quasi-experimental research designs (Fraenkel & Wallen, 2009). To this end, one existing class was taught using multimedia while the other one was not. Various research documents on multimedia were analyzed to get information on the pedagogical importance of multimedia in teaching, questionnaire was used to get information on the provision and usage of multimedia technologies and a test was administered to get students performance. 40 teachers were randomly selected and two classrooms each made of 46 students participated in this study. Qualitative data were analyzed thematically and percentages, means, standard deviations as well as t-test were used to analyze quantitative data. Texts and tables were used to present the findings of this study.

Findings and Discussion

The findings are presented in accordance with the objectives of the study.

a) Provision of multimedia tools in secondary schools

The first objective of this study was to disclose the degree to which multimedia tools are provided in the selected schools in Rwanda. To this end, a questionnaire has been administered to 40 teachers to get information on the availability of multimedia tools in their schools. The following table summarizes the findings:

Table 1: provision of multimedia tools

Multimedia	Frequency	Percentage
TV Screen	12	57.14%

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DVD/VCD	8	38.1%
Projector	2	9.52%
Computer	18	85.71%
CD player	12	57.14%
Multimedia software	0	0%
Internet	3	14.29%

Table 1 shows that schools are poorly equipped with multimedia tools. As the table indicates, only 57.14% of teachers confirmed that their schools are equipped with TV screens, 38.1% with DVD/VCD, and only 9.52% are provided with projectors. Furthermore, 85.71% of teachers confirmed that their schools are equipped with computers, 57.14% confirmed that their schools are equipped with CD players while none of them confirmed that their school possesses any multimedia software. Finally, only 14.29% of teachers confirmed that their schools have access to internet. These findings are in agreement with the statistics provided in the report of the Rwandan Ministry of education which revealed that secondary schools in Rwanda are not sufficiently provided with multimedia tools (Mineduc, 2013). The same report states that there is limited provision of internet in secondary schools where only 18% of secondary schools in Rwanda have access to internet.

b) The use of multimedia in teaching and learning sciences

The second objective of this study was to highlight the extent to which teachers use multimedia in their daily teaching of sciences. The following table summarizes the results:

Table 2: Frequency of the usage of multimedia in selected schools

Multimedia	Always		Sometimes		Rarely		Never	
	f	%	f	%	f	%	f	%
TV Screen	0	0%	2	5%	2	5%	36	90%
DVD/VCD	0	0%	4	10%	2	5%	34	85%
Projector	0	0%	0	0%	0	0%	40	100%
Computer	0	0%	8	20%	4	10%	28	70%
CD player	0	0%	3	7.5%	3	7.5%	34	85%
Multimedia software	0	0%	0	0%	0	0%	40	100%
Internet	0	0%	7	17.5%	6	15%	27	67.5%

Table 2 indicates that majority of teachers never use multimedia tools in teaching science subjects. The table indicates that 90% of teachers never use TV screen, 85% never use DVD/VCD and all of them never use projector for teaching purposes. This may be due the fact that most of the schools are not equipped with these tools as it is shown in table. Although computers are sufficiently provided, 70% of teachers never use them for teaching purposes. Table 2 also shows that 85% of teachers have responded that they never use CD player to teach while none of them use any specific multimedia software. Finally, despite availability of internet in some schools, 67.5% of teachers never use it for teaching purpose. These findings coincide with the findings of Amenyedzi, Lartey, and Dzomeku (2011) who in their study conducted in Ghana revealed that although computers bring change in the way students learn, there is limited use of computers in teaching. Similarly, these findings go hand in hand with those of Roekel (2008) who said that despite the progress of ICTs, the use of computers and ICTs is not fully included in school. Limited use of multimedia technologies is an obstacle to sciences education as many research findings revealed that the use of multimedia fosters acquisition, remembrance, retention of knowledge, develops students' innovative thinking, their decision-making skills, and changes their attitudes toward sciences among many others (Ghazzawi, 2002, Yunis, 2005, Nasr, 2005, Allen, 1998).

c) Multimedia and performance of students

The fourth objective of this study was to find out whether using multimedia technologies in the process of learning and teaching impacts on students' performance. To do so, before the experiment a pre-test was administered to both



experimental and control groups and after experiment a post-test was administered to both groups. The following table summarizes the findings.

Table 3: Impact of multimedia on students' performance

Group	Pre-Test		Post-Test		T-Value	Sig.
	Mean	SD	Mean	SD		
Control	37.8	1.437	38.6	1.231	3.639	.002
Experimental	38.3	1.316	42.938	1.239	10.522	.000

Table 3 shows that there is an important statistical difference in the grades of the experimental and control groups. The results of the pre-test (Mean= 37.8, SD= 1.437 for control group and Mean= 38.3, SD =1.316 for experimental group) indicate that although the two groups were not randomly selected, they were almost equivalent. The results of the post-test (Mean=38.6, SD=1.23 for control group and Mean=42.938 for experimental group) indicate that experimental group performed better in the post-test compared to the control group. This therefore stresses the significant effect of multimedia on the students' academic achievement. This finding goes hand in hand with the findings of Aloraini (2012), Salem (2000) Yunis (2005), Ghazzawi (2002), Nadar (2003), Da'lij (2008) and more others who in their experimental or quasi-experimental research found that multimedia technologies are effective in teaching whereby significant alterations was recognized in performance of the group that was taught using multimedia.

d) Challenges encountered by teachers in using multimedia devices

The last objective of this study was to discover the difficulties that are encountered by teachers when they are using multimedia tools in teaching. The following are some of the challenges they face:

- Difficulty to access to multimedia content
- Teachers are not skilled enough to use multimedia technology
- Lack of conducive environment and support from school leaders
- Lack of electricity in some schools
- Insufficiency of multimedia tools in their schools.

These challenges have also been raised by Roekel (2008) who found that the rhythm of incorporation of ICTs in instruction is attributed to lack of satisfactory information, resources and the skills. Similarly, Pedro (2005) emphasizes that lecturers need to be trained on educational benefits of multimedia technologies for them to use effectively multimedia technologies in education.

Conclusion and recommendations

Multimedia are of paramount importance in teaching and learning sciences. They promote problem solving, facilitates acquisition and retention of knowledge, develops innovative thinking and enhances academic achievement. In view of this, it was found that despite the commitment of the government of Rwanda to promote ICT in education, multimedia tools are not sufficiently provided in selected schools. In fact, the studied revealed that apart from computers which are provided at 85.71%, the level of provision for other tools is below 60%. Furthermore, it was found that there is limited use of multimedia technologies in teaching and learning science subjects in the schools understudy. Indeed, the findings revealed that although multimedia technologies are poorly provided, majority of science teachers never use them for teaching purposes. The study also revealed that multimedia technologies have a significant impact on students' performance. Finally, teachers encounter a number of challenges in using multimedia. The challenges encountered include: limited access to multimedia content, lack of skills for teachers to use multimedia and insufficiency of multimedia tools in schools. In view of the findings of this study, first, there is an imperative need to increase the provision of multimedia tools in selected secondary schools for the enhancement of the quality of teaching and learning sciences. Secondly, there is need to sensitize and train teachers on the use of multimedia in teaching and learning science subjects. Finally, multimedia tools should be promoted in the teaching and learning of science subjects.

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