Effectiveness of Offline Video-Based Biology Instructional Materials on Students' Performance in Secondary Schools

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Abstract
This study investigated the effectiveness of offline video-based instructional materials in enhancing students' academic performance in biology lessons in selected secondary schools in Dar es Salaam. The study used holistic multiple case study and quasi-experimental research designs to collect both qualitative and quantitative data using structured questionnaires, interviews and tests. A total of 2 teachers from school A and school B (i.e. one from each school) and 168 students (i.e. 84 from each school) were purposively selected to participate in the study. Analysis by SPSS and data reduction techniques have revealed that offline video-based instructional materials are effective in enhancing students' academic performance in biology in the experimental groups from both schools (P=0.0001) and made students quite positive about learning biology (89.3%) - 97.6%,). As perceived by students, the enhanced academic performance is the result of improved classroom interactions due to the materials. Specifically, the use of offline video-based instructional materials improved interactions between students and biology teachers, amongst students through group activities and between students and the learning resources. Furthermore, the materials enhanced *students' interest in biology (94.0%), and understanding of concepts (92.9%) and made them retain more biology concepts (94.1%). Based on the findings, appropriate recommendations for policy, action and future research are suggested.*

Keywords: *Offline video-based instructional material, Biology, School, Teaching and Learning*

INTRODUCTION

Efforts to integrate different offline video-based instructional materials in education to enhance students' academic performance are widely reported in literature (Voogt, 2010; Collis & Moonen, 2001; Nihuka, 2008; Kafyulilo, 2013; Agyei &Voogt, 2012). Specifically, studies indicate that offline video-based instructional materials are used in education to address a number of challenges of the traditional instructional materials that confront the teaching and learning of biology in secondary schools in most developing countries.

As perceived by students, one of the major challenges of traditional instructional materials is lack of effectiveness in enhancing learning and promotion of academic performance (Kuenzi, 2008 and Olivos-kati, 2006). Another challenge of traditional instructional materials is ineffectiveness in promoting students' interest for learning, in-depth learning and understanding of difficulty concepts in science subjects including biology in secondary schools (Olivos-kati, 2006). Also, as perceived by students, traditional instructional materials are un-motivating and make them lose interest for the subjects because they don't promote in-depth learning and proper understanding of difficult concepts (Makter & Michael, 2011; Kuenzi, 2008 and Olivos-kati, 2006). Furthermore, as reported in literature, challenges of lack of text books, libraries, ICT infrastructure and shortage of competent biology teachers in secondary schools make the learning of biology using traditional instructional materials even worse (Unwin, 2005; Unesco, 2009; Speering & Rennie, 1996).

Studies indicate that majority of students in secondary education are positive to use offline video-based instructional materials and other ICT-supported materials for learning (Kigobe, 2013; Tagoe, 2012; Senzige & Serukesi, 2003; Kafyulilo, 2013). Specifically, as perceived by students, ICTs including offline video-based instructional materials enhance effective students' learning and improvement of academic performance in science including biology (Bude, 1995). This is because offline video-based instructional materials provide opportunity for students to actively engage with the content anywhere and anytime provided they have access to computer or related device (Goh & Fraser, 1998). Additionally, offline video-based instructional materials contribute to critical thinking (Richards, 1999; Alousa, 2007).

Evidence indicate that offline video-based instructional materials contribute in nurturing confidence, critical thinking, self-learning and development of cognitive, psychomotor and affective behavior in students (Choi & Johnson, 2005). They also promote reflective learning as a result of students' engagement with the content (Choi & Johnson, 2005; Aless & Trollip, 2001). Where offline video-based instructional materials are effectively used in biology learning, they contribute to effective students' learning and improved academic performance (Guskey, 2000; Joyce & Showers, 1995; Nihuka, 2011). Offline video-based instructional materials challenge students to develop higher attention span than when traditional instructional materials are used (Choi & Johnson, 2005). According to Choi and Johnson (2005), offline video-based instructional materials help students remember important concepts more easily because they promote simultaneous processing of both auditory and visual information.

Experience from studies indicate that when properly used, offline video-based instructional materials are effective in promoting interest for biology, in-depth learning, access to learning resources and improvement of students' academic performance (Onyegegbu, 2008), language development and cognitive development (Voogt, 2010; Collis & Moonen, 2001). They are also used in secondary schools to address challenges such as lack of reliable internet connectivity, lack of libraries, lack of instructional materials and other text books and lack of advanced digital skills among students and teachers, among others (Terna, Samson & Abdullah, 2018; Ambrose, 2012; Chonjo et al, 1996; Leeuw, 2003; Mokter, 2011 & Unwin, 2005).

The following are the critical conditions that make integration of offline video-based instructional materials in education in the context of developing countries such as Tanzania feasible. First, presence of supportive policies that guide the use of technologies in education. Specifically, the United Republic of Tanzania (URT) through the Ministry of Education, Science and Technology (MoEST) has put in place ICT Policy for Basic Education (URT, 2007) in addition, the Education and Training Policy (URT, 2004) to guide video-based instructional materials integration in secondary schools. Among other things, the said policies create conducive environment for integration of ICT including offline video-based instructional materials in education as a pedagogical tool for teaching and learning to enhance equitable access to learning

resources by students and teachers and facilitation of students' learning and improvement of academic performance in schools (URT, 2007).

Also, as required by policies, technology integration in education is part of the curriculum in Teacher Training Colleges (TTCs) in the country. This is important because such a curriculum equip student-teachers with relevant practical skills about technology integration in teaching (Kigobe, 2013 & Senzige, 2003). Second, presence of basic ICT infrastructure available in some secondary schools which are necessary for integration of offline video-based instructional materials for teaching and learning in secondary schools. Such ICT infrastructures include tablets, computers, projectors and televisions (Kigobe, 2013; Nihuka, 2013 & Senzige, 2003).

However, evidence on the effectiveness of offline video-based instructional materials in enhancing *students' learning and academic performance in biology in the context of secondary schools* in Dar es Salaam are just emerging (Kafyulilo, 2013; Kigobe, 2013; Senzige & Serukesi, 2003). Therefore, the main focus of the study reported in this paper was to investigate the effectiveness of offline video-based instructional materials in enhancing students' *academic performance in biology in secondary schools.* This is because offline video-based instructional materials may be useful in addressing challenges of shortage of learning resources in the context of secondary schools in the country.

OBJECTIVE OF THE STUDY

The main objective of the study was *to investigate the effectiveness of offline video-based instructional materials in enhancing students' academic performance in biology in selected secondary schools in Dar es Salaam.* Specifically, the study addressed the following specific objectives:

i) To explore students' experiences with the traditional teaching and learning of biology.
ii) To examine challenges encountered by students in the traditional learning of biology.
iii) To investigate students' experience with offline video-based instructional materials in learning biology, and
iv) To assess contribution of offline video-based instructional materials in enhancing students' academic performance in biology.

METHODOLOGY

Design of the Study

The study employed *holistic multiple* case study and *quasi- experimental* research designs. A holistic multiple case study was adopted because two independent schools were studied, each as a unit (Yin, 2000) and *quasi-experimental* design was used because the study included experimental and control groups.

Sample and Sampling Technique

A sample of 168 students from biology streams school A and B (actual names withheld) (i.e 84 students from each school) participated in the study. The sample was drawn using purposive sampling technique and only one stream participated in the study as experimental group and the other as a control group in each school.

Instrument for Data Collection

The study used the following four instruments for data collection: *structured questionnaire, interview schedule* and *Test.* The *structured questionnaire* comprised of closed-ended questions where students were required to tick against specific statements provided in a Likert scale (as *Strongly Disagree*, *Disagree*, *Agree* and *Strongly Agree*). *The interview schedule* comprised of open-ended questions where students responded accordingly and responses recorded using audio recorder. The *Test* instrument contained questions aligned to lesson objectives which students were expected to demonstrate mastery at the end of the lesson. Both, *SPSS and Data Reduction Technique* (Miles & Huberman, 1994) were used to analyze quantitative and qualitative data accordingly.

FINDINGS

Students' experiences with traditional instructional materials

Findings on students' experiences with traditional instructional materials in biology learning (in Table 1) indicate that 78 students (92.8%) find materials as interesting. However, students reported several concerns when using the traditional instructional materials during biology learning; limited group activities (43; 51.2%), teacher dominancy (33; 39.3%), delayed timely completion of syllabus (59; 58.4%) and limited practical during biology lessons (49; 49.3%).

Table 1: Students' experiences with traditional instructional materials

	Responses (N= 84)	
Experience	**Freq**	**%**
Traditional instructional materials are interesting	78	92.8
Limited group activities	43	51.2
Teachers use teaching aids	35	31.7
Teacher- centered approach is dominant	33	39.3
Copying notes is common	33	39.3
Limited time for questions	22	26.2
Syllabus not completed on time	59	58.4
Lack of competent teachers in biology	24	28.6
Lack of interest to read books	28	33.3
Limited practical	49	49.3

An independent sample t-test analysis was conducted to compare students' experience with the traditional instructional materials between the two schools. Findings (Table 2) indicate that students at School A experienced limited time for questions ($p<0.05$) and lacked competent biology teacher ($p<0.05$).

Table 2: Comparison of students' experience with traditional instructional materials

	Responses (N = 84)				
	School A		School B		
Experience	**Freq**	**%**	**Freq**	**%**	**T- test**
Traditional instructional materials are interesting	19	70.4	8	26.9	t(82)=-0.985, p>0.05
Few group activities	20	57.1	15	42.9	t(82)=0.721,p>0.05
Teachers do not use teaching aids	13	53.1	9	40.9	t(82)=0.010,p>0.05
Teacher-centered approach is dominant	49	22.2	14	77.8	t(82)=-2.92p>0.05
Copying notes is common	1	11.1	8	88.9	t(82)=-5.79p>0.05
Limited time for questions	3	17.6	14	82.4	t(82)=-5.01,p<0.05*
Delayed finishing of syllabus	13	52.0	12	48.0	t(82)=-5.23,p>0.05
Lack of competent biology teacher	4	33.3	8	66.7	t(82)=-5.02,p<0.05*
Lack of interest to read books	9	56.3	7	43.8	t(82)= 0.69, p>0.05
Limited practical work	16	50.0	16	50.0	t(82)=-1.96,p>0.05

Note: * = *Statistically significant difference*

Challenges of traditional instructional materials

Challenges that students encountered when using traditional instructional materials in biology learning were also investigated. Findings (Table 3) indicate that students encountered challenge of lack of biology text books for reference (52; 61.9%), limited practical work (52; 53.6%) and limited

use of library (60.7%). Furthermore, students encountered challenge of limited learning resources (45; 53.6%) and lack of computers to support learning (60; 71.4%).

Table 3: *Challenges encountered by students when using traditional instructional materials*

	Responses (N= 84)	
Challenges	**Freq**	**%**
Lack of interest to learn biology	12	14.2
Lack enough biology text books for reference	52	61.9
Limited practical	52	61.9
Limited use of library	51	60.7
Difficult to learn biology concept	17	20.3
Limited learning resources	45	53.6
Lack of interactions with biology teacher	31	36.9
Big class size (over 100 students/class)	35	41.6
Limited group discussions	38	35.3
Lack of computers to support learning	60	71.4
Boring teaching methods	26	31.0

A comparison of the challenges as perceived by students in the two schools (Table 4) indicate that students in School A lack interest in traditional instructional materials, have limited practical, experience big class size and lack computers to support biology learning unlike their counterparts in School B ($P<0.05$ in favor of School A). On the other hand, students in School B lack biology books and other learning resources compared to their counterparts in School A ($P<0.05$ in favor of School B).

Table 4: Comparison of challenges of traditional instructional materials

Challenges	**Responses (N=84)**				
	School A		**School B**		
	req	**%**	**Freq**	**%**	**T-test**
Lack of interested with traditional instructional materials	5	83.3	1	16.7	$t(82)=2.285$, $p<0.05$*
Lack of enough biology books	10	43.5	13	56.5	$t(82)=-3.643$, $p<0.05$*
Limited practical	17	53.1	15	46.9	$t(82)=-3.182$, $p<0.05$*
Limited use of library by students	7	41.2	10	58.8	$t(82)=-1.715$, $p>0.05$
Dislike the way biology is taught	5	38.5	8	61.5	$t(82)=0.725$, $p>0.05$
Difficult to learn biology concepts	9	64.3	5	35.7	$t(82)=1.009$, $p>0.05$
Lack of interactions	7	36.8	12	63.2	$t(82)=-0.458$, $p>0.05$
Big class size (over 100)	13	83.3	3	16.7	$t(82)=5.382$, $p<0.05$*
Limited discussions	15	60	10	40	$t(82)=0.467$, $p>0.05$
Lack of computer to support T/L	7	58.3	5	41.7	$t(82)=2.582$, $p<0.05$*

Note:*= *Statistically significant difference*

Students' experience with offline video-based instructional materials

Findings on students' experience with offline video-based instructional materials in biology learning (Table 5) indicate that students are positive about the materials (89.3% - 97.6%). Offline video-based instructional materials enhanced students' interest in learning biology (79; 94.0%), promoted understanding of biology concepts (78; 92.9%) and recommended the materials to be used by other biology teachers (82; 97.6%)..

Table 5: Students' experience with offline video-based instructional materials

	Responses (N= 84)	
Experience	**Freq**	**%**
Offline video-based instructional materials enabled understand of biology concepts	78	92.9
Made simple to understand difficult biology concepts	75	89.3
Offline video-based instructional materials helped to learn more about biology	79	94.0
Offline video-based instructional materials increased interest in biology	79	94.0
Offline video-based instructional materials enhanced comprehension of concepts	75	89.3
Retained more biology concepts when offline video-based instructional materials are used	79	94.1
Liked learning using offline video-based instructional materials	79	94.0
Use of offline video-based instructional materials to be compulsory for other teachers	82	97.6

Findings from interviews with students echo those presented in Table 5. Specifically, as perceived by students, *"offline video-based instructional materials improved the learning of biology compared to traditional instructional materials".* According to students*, "lesson which used offline video-based instructional materials were more engaging with full of group activities unlike in the lessons which used traditional instructional materials, the said materials enhanced understanding of biology concepts due to practical observations, increased confidence, concentration and prevented dozing in class".*

Comparison of students experience with offline video-based instructional materials between the two schools (Table 6) indicate that students in School A found the materials made the understanding of difficult biology concepts easier and increased interest to learn biology than their counterparts in School B($P<0.05$ in favor of School A).

Furthermore, students in School A reported that the level of comprehension of biology was enhanced and could retain more biology concept as a result of the materials unlike their counterparts in School B ($p<0.05$ in favor of School A.

Table 6: Comparison of students experience with offline video-based instructional materials

	Responses (N=84)				
	School A		School B		
Experience	**Freq**	**%**	**Freq**	**%**	**T-test**
Offline video-based instructional materials made me understand biology more	12	92.3	1	7.7	t(82)=-2.85,p>0.05
Easier to understand difficult concepts	16	84.2	3	15.8	t(82)=3.78'p<0.0*
Offline video-based instructional materials helped learn more about biology	15	88.2	2	11.8	t(82)=-2.84,p>0.05
Offline video-based instructional materials increased interest for biology	15	93.8	1	6.3	t(82)=3.09,p<0.0*
Enhanced level of biology comprehension	11	57.9	8	42.1	t(82)=-3.11, p<0.05*
Retained more biology concepts	29	83.3	4	16.7	t(82)=-2.10, p<0.05*
Liked offline video-based instructional materials	7	77.8	2	22.2	t(82)=-1.67,p>0.05
Use of offline video-based instructional materials should be compulsory	11	91.7	1	8.3	t(82)=-1.60,p>0.05

Note: * = *Statistically significant difference*

Contribution of offline video-based instructional materials on students' academic performance

Findings from test (Table 7) indicate that students in the offline video-based instructional materials in both schools performed significantly better compared to their counterparts in the control groups (M = 34.8% v/s M = 30.3% in School A and M = 30.8% v/s 39.9% in School B: p<.0001). However, comparison between the experimental groups in the two schools indicated that, students in School B performed better

academically (M = 58.3%; SD = 1.1) compared to their counterparts in School A (M = 34.8%; SD = 0.4).

Table 7: Contribution of offline video-based instructional materials on students' performance

Schools	Students' Academic Performance (N= 84)						T-Test
	Experimental Group			Control Group			
	n	M	SD	n	M	SD	
School A	46	34.8	0.4	46	30.3	0.05	t(84)=-125.0418, p<0.0001
School B	38	58.3	1.18	83	39.9	0.02	t(84) =-303.9208, p<0.0001

As perceived by students, *the improved academic performance is the result of the enhanced interactions due to offline video-based instructional materials during biology learning*. Specifically, *the use of offline video-based instructional materials enhanced interactions with biology teacher who gave us* (students) *the opportunity to seek for further clarifications about concepts unlike when traditional instructional materials are used.*

Also, as indicated by students, *offline video-based instructional materials enhanced interactions amongst students through group activities where we engaged into discussion about specific concepts and issues related to biology. Also, we* (students) *got opportunity to note down own conclusions for sharing in plenary discussion during the lesson. Offline video-based instructional materials enhanced interactions between students and learning resources where we* (students) *were able to address questions that were provided during the lesson.*

CONCLUSIONS AND DISCUSSION

The study reported in this paper investigated effectiveness of offline video-based instructional materials in enhancing students' academic performance in biology learning in selected secondary schools in Dar es Salaam. Findings have indicated that in the context of the study, offline video-based instructional materials are effective in enhancing students' learning and improvement of academic performance in biology learning in the experimental groups in both schools.

As perceived by students, the improved academic performance is the

result of the enhanced interactions due to the use of offline video-based instructional materials in biology learning. Specifically, the use of offline video-based instructional materials enhanced interactions between students and the biology teacher, amongst students through group activities and between students and learning resources. According to Richards (1999) and Alausa (2007), learning interactions are essential for effective learning and improvement of students' academic performance. This indicates that offline video-based instructional materials improved significantly the teaching and learning of biology in the selected schools. Similar findings are also reported in previous studies by Cox (2003a); Pittard (2003); Harrison (2002) and Passey (2004).

Findings have also indicated that students in one of the selected schools encountered several challenges when using traditional instructional materials, which included limited practical, big class size and lack of ICT infrastructure such as computers compared to the other school that experienced lack of biology books and learning resources. Generally, traditional instructional materials make students lack interest for biology and experience poor academic performance (Unwin, 2005; Unesco, 2009; Ambrose, 2012).

Furthermore, as a result of offline video-based instructional materials, majority of students in both schools were positive about biology learning. According to students, the instructional materials enhanced their interest for biology, promoted their understanding about difficult biology concepts and therefore recommended for other biology teachers to also integrate similar materials in their lessons.

Furthermore, students have indicated that offline video-based instructional materials made learning of biology further improved compared to when traditional instructional materials are used because the approach engaged them with activities which enhanced their understanding. This conclusion corroborates to that by Choi and Johnson (2005). According to Choi and Johnson (ibid), offline video-based instruction enhance students' attention span and help them remember important concepts.

Based on the findings from this study, relevant recommendations for policy, action and future research are suggested. In terms of policy, there is need for review of the current National Education Act to accommodate

ambitions about educational technologies integration as stipulated in the revised National Education and Training Policy (2023 version) to improve teaching and learning processes in schools. This is because findings have indicated that technologies such as offline instructional materials are effective in enhancing students' learning and academic performance.

For action, there is need for teachers in biology and the rest of the subjects to integrate offline video-based instructional materials in teaching and learning of their subjects. This shall enhance classroom interactions and improve students' learning and academic performance. There is also need for further research to investigate the use of online video-based instructional materials to enhance learning flexibility in tertiary education in the context of Tanzania.

REFFERENCES

Agyei, D.D., & Voogt, J. (2012). Developing technological pedagogical content knowledge in pre-service mathematics teachers through collaborative design. *Australasian Journal of Educational Technology,* 28(4), 547-564.

Ambrose B. M. (2012). Challenges faced by teachers in implementing learner-centred approaches: A case study of selected government schools in Ilala District, Dar es Salaam. Masters dissertation, Open University of Tanzania.

Benard, R & Dulle, F. (2015). Assessment of Access and Use of School Library Information Resources by Secondary Schools Students in Morogoro Municipality, Tanzania.*Library Philosophy and Practice (e-journal)*. 1107. http://digitalcommons.unl.edu/libphilprac/1107.

Chonjo, P. N., Osaki, K.M., Possi, M., & Mrutu, S. (1996). *Improving science education in secondary schools: a situational analysis of selected government secondary schools in Tanzania mainland*. Dares Salaam, Tanzania.

Collis, B., & Moonen, J. (2001). *Flexible learning in a digital world: Experiences and expectations*. London: Routledge.

Hadiprayitno, G, Muhli, S & Kusmiyat, T (2019). Problems in learning biology for senior high schools in Lombok Island. Journal of Physics, (2019). *Conf. Ser.* 1241, DOI:10.1088/1742-6596/1241/1/0120542.

Guskey, T. R. (2000). *Evaluating professional development*. Thousands of Oaks: Corwinn Press.

Joyce, B., & Showers, B. (1995). *Student achievement through staff development: Fundamentals of school renewal* (2nd ed.). White Plains, NY: Longman.

Kafyulio, A.C. (2013). Collaborative deign in teams to develop science and mathematics teachers' technology integration knowledge and skills. Doctoral thesis, University of Twente, Enchede.

Kigobe, J. (2013). *Current situation on challenges and application of ICT in secondary schools in Tanzania.* Masters Thesis, Northeast Normal University of China.

Lyons, T. (2005). Different countries, same science classes: students' experiences of school science in their own words. *International Journal of Science Education.* (Retrieved from http:// research.acer.edu.au.aer/3 on 20th July, 2014).

Miles, M. B., & Huberman, A. M (1994). An expanded source book, qualitative data analysis. 2nd edition. London, SAGE Publications.

Mokter, H. & Michael, R. (2011).US-China education review, ISSN 1548-6613.

Matemu, F.P (2014). The impact of video-based instructional materials on students learning of biology. MED (APPS) dissertation, Open University of Tanzania, Dar es Salaam, Tanzania.

Nihuka, K. A & Ambrose, B. M. (in-press). Challenges of implementing learner-centred curriculum in secondary schools in Dar es Salaam. Submitted for publication in *Journal of Adult Education Tanzania* (JAET).

Nihuka, K. A. (2011). Collaborative course design to support e-learning implementation by instructors. Doctoral thesis, University of Twente, Netherlands.

Nihuka, K. A. (2008). Feasibility of implementing e-learning at the Open University of Tanzania. Masters dissertation, University of Twente.

Onyegegbu, N (2008). Using new technologies in creating excitement in biology laboratory activities. Educational Research and Review Vol. 3 (1), pp. 010- 013, January 2008

Senzige, J. P., & Sarukesi, K. (2003). An approach to ICT based school education in Tanzania. Africa Studies Association of Australia and the Pacific 2003 Conference, Proceedings-Africa on a Global Stage.

Tagoe, M. (2012). Students' perceptions on incorporating e-learning into teaching and learning at the University of Ghana. *International Journal of Education and Development using Information and Communication Technology (IJEDICT),* 8(**1**), 91-103.

Terna, I. G., Samson, K & Abdullah, J. (2018). An investigation into the

problems facing the teaching and learning of mathematics in secondary schools in makurdi local government area of Benue state. *ABACUS, Mathematics Education Series, 43 (1). The Journal of Mathematical Association of Nigeria*, 43(1), 419-422.

URT. (2007). National ICT policy for basic education. Dar es Salaam, Tanzania.

URT. (2010). Secondary Education Development Program (SEDP II), Dar es Salaam, Tanzania

Voogt, J., Almekinders, M., Van den Akker, J., & Moonen, B. (2005). A blended in-service arrangement for classroom technology integration: Impacts on teachers and students. *Computers in Human Behavior*, 21 (2005) 523-539.