ICT BASED INSTRUCTION AND THE DEVELOPMENT OF HIGHER ORDER LEARNING SKILLS IN PRIMARY SCHOOLS

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ABSTRACT

The aim of this study was to investigate "the effects of ICT based instruction on the development of higher order learning skills in primary schools". Primary school teachers still face challenges to transform pupils learning processes through the use of innovative technologies. The study made use of quasi-experimental research design which employed the achievement test as the main tool of data collection. The arguments for the study anchored on Jean Piaget's (1896-1980) theory of constructivism and Lev Vygotsky's (1978) theory of social constructivism. The population of the study was made up of primary school pupils from Queensway Bilingual School Essos Yaoundé and Children's World Learning Centre Yaoundé V in Mfoundi Division. From this population, 110 pupils from class five and six were selected for the study through simple random sampling technique. Findings shows that there was a significant difference in the performance of pupils in the experimental group and the control group: $F(108) = 1.477$, $p < 0.05$. This shows that higher order learning skills were developed when primary school pupils were taught with the use of ICT. It is important for educators and researchers to have a good grasp of technology and its advantages. Findings also recommend that efforts should be oriented towards changing mind set and helping educators to understanding the changing role of the teacher from instructor to facilitator.

Key words: *ICT based instruction, Pedagogy, Technology integration and Higher Order Learning Skills*

Background of the study

Information and Communication Technologies is an important research area for many researchers and educationist across the world. The way ICT is used has changed the face of education over the last few decades and has the potential to help learners develop higher order learning skills in primary schools. The use of ICT in education and training has become a priority during the last decade and only a small percentage of schools in some countries have achieved high levels of effective use of ICT to support and change the teaching and learning process in many subject areas (Elmaifi, 2014). Technology integration in primary schools is important because it extends the learning experience which raises standards across the curriculum to improve the delivery of lesson content. ICT in education allows pupils to engage in class in a variety of ways. It takes teaching and learning beyond the four walls of the classroom. ICT use in teaching also enriches the curriculum which provides access to a whole host of information and encourages collaborative working and communication with others. With ICT, the world is effectively brought into the classroom and pupils become more engaged in their learning. ICT expands learning horizons that enable access to fast internet connections and allows for learning materials to be viewed, downloaded and worked through quickly. Technology helps in assessment where pupils' data can be recorded and analysed more efficiently for accurate assessment and evaluation of learning abilities. It also allows teachers to see those areas of learning which need a higher level of support.

ICT as a pedagogical tool can provide a new framework to improve the teaching and learning process. This can be done in a collaborative, project-based as well as self-paced way. ICT has become important in research, library, documentation, and the use of technologies have opened a new door for human activities and in view of increasing

productivity, ICT is a very important tool in education from classroom to the top management team. ICT plays the role of diminishing the burden of the administration of the school. With technology integration in the teaching learning process, there is the existence of a more effective and integrated flow of information among teachers, students and non-teaching staff (Hepp, Hinostroza, Laval & Rehbein, 2004).

While studying the use of ICT in the classroom by primary school teachers, it has been observed that technology is often used for personal or administration purposes. It has also been realized that the most frequent uses of ICT are word processing, Internet research, email, and PowerPoint (Dawson, 2008; Koc & Bakir, 2010; Yeung et al., 2012; Young, 2009). ICT has the potential in preparing learners for life in the 21st century. Through the learning of ICT skills, learners are ready to face future challenges based on proper understanding (Grimus, 2000). ICT use can help kids to develop the competencies needed for the current globalization (Bransford, Brown, & Cocking, 2000). ICT can help learners to develop their skills, boost up their motivation and widen their knowledge and information (Grabe & Grabe, 2007; Hussain et al., 2011). Information and Communication Technology (ICT) is important in primary education because it can help kids to search for the information they need and to organize what they have found

Research studies in primary schools in Cameroon show that inadequate training on ICT integration in the classroom has been given to teachers who are in the field to improve their skills and knowledge since 2001 when ICT was introduced in schools (Inspectorate of Pedagogy in charge of ICTs, annual reports, 2009, 2010, 2011, Nkwenti, 2015). The ICT syllabuses and National Sequential Schemes of work published in 2008 were made available to Nursery, Primary and Teacher Training Education (Ngajie & Ngo, 2016). Textbooks have also been written and adopted by the National Book Commission to facilitate the teaching of ICTs (Mbangwana, 2008). And the draft strategy to implement the national ICT policy in basic education which was applicable from 2007-2015 was also developed in 2007 (Ngajie & Ngo, 2016). Primary school teachers still face challenges to transform pupils learning process by providing them with opportunities to develop cognitive abilities with innovative technology. *The main objective of the study was to investigate the effects of ICT based instruction on the development of higher-order learning skills in primary schools.*

Literature review

Integration of Information and Communication Technology (ICT) in education concerns the use of computer based communication that incorporates into daily classroom instructional process (Ghavifekr & Rosdy, 2015). Relating to preparing learners for the current digital era, teachers are the key players in using ICT in their daily classrooms (Ghavifekr & Rosdy, 2015). The aim of ICT integration is to improve and increase the quality, accessibility and cost-efficiency of the delivery of instruction to learners (Albirini, 2006). ICT integration in education implies technology-based teaching and learning process that closely relates to the utilization of learning technologies in schools (Ghavifekr & Rosdy, 2015). When learners are familiar with technology based environments, they learn better because technology contributes a lot to the pedagogical aspects in which the application of ICT will lead to effective learning with supports from ICT elements and components (Jamieson-Procter et al., 2013, Ghavifekr & Rosdy, 2015).

Hew & Brush (2007) define technology integration as using computers, laptops, personal digital assistants (PDAs), software and internet for instructional purposes at schools To Perkmen (2008), technology integration is related to technology use in the teaching and learning process while Reigeluth (2003), considers technology integration as using technology to enhance the quality of teaching and learning process.

Effective technology integration does not mean using technologies to teach the same content in the same way; instead to use technology for providing opportunities to support new models of learning, including opportunities for learners to collaborate and construct knowledge (Protheroe, 2005). For technology integration to be successful, it must be routine, seamless, and both efficient and effective in supporting school goals and purposes (NFES, 2002; Ogle et al., 2002). Technology integration is also seen as the use of technology to achieve learning goals and to empower students learning throughout the instructional program (Cartwright & Hammond, 2003; Koçak-Usluel, Kuúkaya-Mumcu, & Demiraslan, 2007).

The three areas of ICT integration are curriculum (macro), topic (meso), and lesson (micro) (Wang & Woo, 2007). ICT integration in the curriculum normally requires ICT to support a more substantial amount of subject content, such as a complete course containing several topics in a specific discipline like science. Examples of such ICT integration are multimedia curricula delivered in CD-ROMs (Wang & Woo, 2007) or web-based courses. In the

topic area, ICT can be used to cover certain topics within a course. A topic usually involves a series of smaller pockets of knowledge, such as DNA or cell division, which are usually interrelated to elaborate concepts. At the micro level, ICT is used to help explain specific knowledge units, such as DNA within a single lesson (Wang & Woo, 2007). Audio media are media heard not seen and they involve radio broadcast, audio discs, and audio tape. To Tambo (2003), the radio is relatively a cheap medium of instruction and is very suitable for learning opportunities to a large area or in a small concentrated area. The radio is suitable in presenting learning experiences in the form of music, language, history, literature, drama and in many social areas. Radio provides programs like newscasts, forum, editorials, human rights, home management, and entertainment. Schools can use parts of these programs that are broadcast over the radio network for teaching and learning processes (Tambo, 2003). For audio discs, they are both suitable for recording of music, speeches and playing to a class or group in a learning situation.

According to the National Educational Technology Standards for Students: The Next Generation (NETS-S; ISTE, 2007), emphasis is on technology as a tool for research, communication, collaboration, problem solving, and decision making, which are essential skills for teaching and learning. The standards identify six core components that include Creativity and Innovation, communication and collaboration, research and information fluency, critical thinking, problem solving and decision-making, digital citizenship, technology operations and concepts (NETS-S; ISTE, 2007). With creativity and innovation, learners use technology to demonstrate creative thinking, construct their own knowledge and develop innovative products and processes. Digital media enable learners to communicate and work collaboratively at a distance, to support individual learning and contribute to the learning of others in the classroom (NETS-S; ISTE, 2007). Jones (2002), pointed out that teachers need to have a good understanding of computer hardware and software to teach students using good pedagogical practices. Bitner and Bitner (2002), add that teacher needs to learn to use the technology and allow the technology to change their teaching paradigm. According to Serim and Koch (1996), pupils can direct their own learning when using the Internet and ICT can also encourage them to use higher order thinking skills to solve problems. The Internet actively supports pupils' learning and higher order thinking by eliminating barriers to accessing information (Serim & Koch, 1996). Computers can improve student engagement and provide interaction in a multi-sensory form (Cooper &Brna, 2002). According to Prensky (2005), teachers need to prioritise engagement over content when teaching and that outside of school students are engaged in their digital lives and therefore teachers need to engage pupils' in primary schools electronically.

The use of ICT as well as other teaching strategies can enable learners to move to higher-order levels of thinking (Jonassen & Carr, 2000; Kearney & Treagust, 2001; Oliver & Hannafin, 2000). The students are learning to prepare themselves for the future information age and to Kozma (2005). ICT can be used to enhance student understanding and increase the quality of Education.

According to Wilson (1996), a constructivist learning environment is a place where learners work together and support each other as they use a variety of tools and information sources in their guided pursuit learning goals and problem-solving activities (Erhan & Hasan, 2017). A constructivist learning environment focuses on learning rather than teaching and flexibility is at the forefront in this type of learning environment and the teacher's role is guiding, counselling, and giving learners the necessary support (Jonassen, 1999; Wilson, 1996, Erhan & Hasan, 2017). In the constructivist learning environment, learners are given a problem to solve and this improves both their knowledge and cognitive skills (Erhan & Hasan, 2017). Technology is used for preparing and presenting a pre-planned layout and performs tasks like researching information, presenting, communicating, support, and collaboration during the problem-solving process (Erhan & Hasan, 2017). Hannafin, and Wang (2005), add that technology as cognitive tool offers substantial potential to improve learning but requires investigation to determine the factors that affect their successful application

Technology is not used only for preparing and presenting a pre-planned layout because constructivism requires various technologies in tasks such as research, presentation, communication, support, and collaboration during the problem-solving process (Ünal & Çakir, 2017). In the constructivist learning environment, technology plays an important role in terms of access to learning sources, communication with other students, and cognitive tools usage (Ünal & Çakir, 2017). Technology concerns cognitive tools such as computers and other related technologies (Jonassen and Reeves, 1996). Technology is not only for presenting information as in traditional use, but it is also used for assisting students in finding, interpreting, organizing, sharing, and presenting the information (Jonassen & Reeves, 1996). Therefore, technology should be for the learner, not for the teacher and dynamic web technologies have the potential to develop students' skills concerning problem solving, collaboration, critical thinking, and self-regulated learning skills (Ünal & Çakir, 2017). Constructivism's supporters suggest that the ways in which

technologies are applied in schools must be changed from 'technology-as-teacher' to 'technology-as-partner' in the learning process and that students do not learn from technology nor can they be taught directly by technology. Rather, pupils ought to learn from thinking and to use technology to teach themselves and others (Jonassen et al., 2003). Technology can be used by pupils in the classroom to help them organise, restructure, and represent what they know (Jonassen & Reeves, 2001; Jonassen et al. 1998; Liu and Bera, 2005). Also, teachers are continually in conversation with the students, creating the learning experience that is open to new directions depending upon the needs of the student as the learning progresses(McLeod, 2015).Teachers following Piaget's theory of constructivism must challenge the student by making them effective critical thinkers and not being merely a "teacher" but also a mentor, a consultant, and a coach (McLeod, 2015).

With social constructivism, through social interaction by the teacher and pupils using ICT tools, good teaching methods, strategies and skills, higher order thinking skills are developed with a collaborative process of actual development and potential development (Desai, Hart, and Richards, 1998). Instructors should invest time and effort to create a successful ICT -learning environment so that pupils' level of cognitive abilities can be increased. ICT based instruction requires distinct interaction with learners and high technology devices providing a strong interaction between the learner, learner and instructor, and the content as well as other learners in the classroom (Desai et al., 1998).

Methods

This study was carried out in Yaoundé V Sub Division specifically in Children World Learning Centre and Queensway Bilingual School Essos. Yaoundé V Sub Division is found in Mfoundi Division, Center Region of the Republic of Cameroon. The target population comprised of level three pupils and teachers. Purposive sampling technique was used to select the schools given that they have multimedia centres. The sample was made up of 110 pupils selected from level three of the aforementioned schools. The study employed the Quasi-Experimental Design where Non-equivalent group post-test were used as the subjects (pupils) were assigned to two groups. The treatment was given to one group (experimental group) while the other group (control group) was taught using the traditional method. At the end of the treatment, a post-test was given to the two groups and the results were compared.

Data were collected using achievement test to capture higher order learning skills after planning, delivery and assessments of those lessons in the experimental and control groups. A ten test items on Listening Comprehension in English Language was constructed based on higher order learning skills of Bloom Taxonomy and administered to pupils to determine their level of retention and critical thinking. This was through non-equivalent post-test in the treatment and control groups to compare the results. The post-test administered in both groups were to compare the outcome of their results. The items on the test had blank spaces where senior primary pupils expressed their level of retention by answering questions which were developed using verbs that involved analyses, syntheses and evaluation such as explain, propose, justify, discuss and evaluate.

To establish content validity, the instruments were scrutinised by the researchers by checking the relevance of the items with respect to the objectives of the study. After scrutinising the items, Content Validity Index (CVI) was calculated first after which the inter-judged coefficient of validity was calculated, and it stood at 0.897.

The reliability of the instrument used was determined using test-retest reliability. Before administering the test to pupils, they were first tested to a group of 20 pupils. After two weeks, the same test items were still conducted to the same group of pupils. Their responses were correlated, and the results showed a high degree of consistency. Cronbach's alpha and confirmatory factor analysis techniques were used to determine the reliability and validity of the instruments. Reliability was assessed post hoc using Cronbach's alpha ($r = .99$),

Data were analysed with the use of tables, charts, percentages, mean and standard deviations. Also, the Statistical Package for Social Sciences (SPSS) version 25.0 for Windows was used for data analysis. To organize and give meaning to our data, the researchers made use of descriptive statistics, univariate analysis of variances (ANOVA), Pearson Product Moment Correlation Coefficient and Stepwise multiple regression analysis.

Findings

Table 1: *Group Statistics for pupils' performance by gender*

	Gender	N	Mean	Std. Deviation	Std. Error Mean
Performance	Female	56	12,982	4,677	,625
	Male	54	13,111	4,624	,630

Table 1 shows that the sample was made up of 56 Females and 54 Males.

Table 2: *Independent Sample t -test for pupils' performance by gender*

		Levene's Test for Equality of Variances		t-test for Equality of Means		
		F	Sig.	T	Df	Sig. (2-tailed)
Performance	Equal variances assumed	,091	,764	-,145	108	,885
	Equal variances not assumed			-,145	107,930	,885

The results in table 1 and 2 show a significant variability of performance in the study for female pupils (M = 12.982, SD = 4.677) and male pupils (M = 13.111, SD = 4.624), t (108) = -, 145 (p > 0.05). Therefore, gender does not influence the development of higher order learning skills of primary school pupils.

Table 3: Distribution of pupils' respondents according to groups

	Frequency	Percent	Cumulative Percent
Control group	56	50,91	50,91
Experimental group	54	49,09	100,00
Total	110	100,00	

The distribution of pupils' respondents according to groups is observed in table 3. The table shows that 56 pupils with a percentage of 50.91% made up the control group while 54 pupils with a percentage of 49.09% constituted the experimental group

Table 4: *Analysis of the effect of group on performance*

	Group	N	Mean	Std. Deviation	Std. ErrorMean
Performance	Control group	56	12,160	4,85340	,64856
	Experimental group	54	13,963	4,23803	,57672

Table 5: *Independent Sample t -test for performance by group*

		Levene's Test for Equality of Variances		t-test for Equality of Means		
		F	Sig.	T	Df	Sig. (2-tailed)
Performance	Equal variances assumed	1,477	,227	-2,071	108	,041
	Equal variances not assumed			-2,077	106,965	,040

The results show a significant variability of performance in the study for the control group (M = 12.160, SD = 4.853) and experimental group (M = 13-963, SD = 4.238), t (108) = -2.071, (p < 0.05). This reveals that the group has an influence on the development of higher order learning skills.

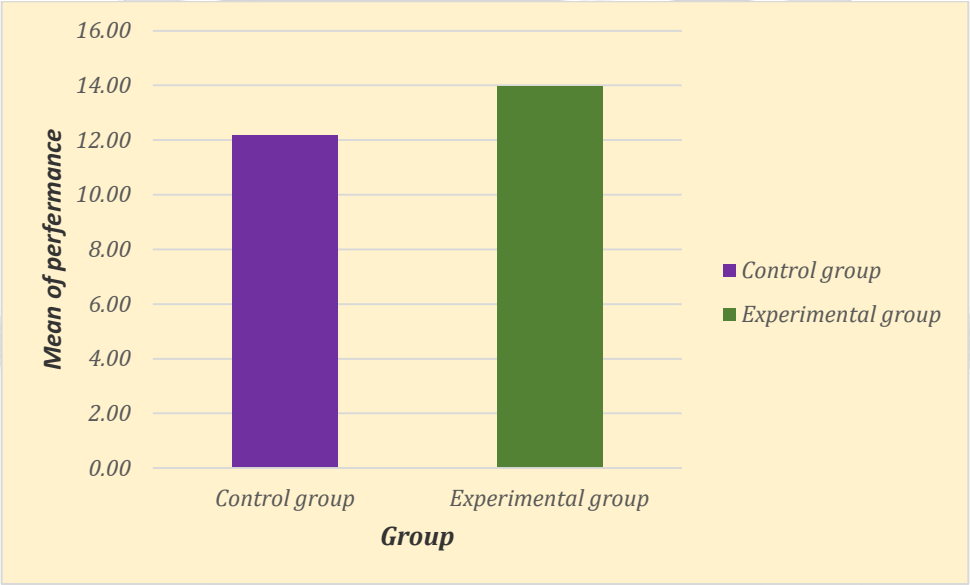

Figure 1: *Graph of the variability of performance by group*

The overall analysis as illustrated in figure 1 shows a significant difference of performance for the different groups: F (108) = 1.477, p < 0.05: meaning that the development of higher order learning skills was significantly influenced by group as pupils performed better in the experimental group than in the control group.

Discussions

From the study there was a significant difference in the performance of pupils in the experimental group and the control group: F (108) = 1.477, p < 0.05. This shows that higher order learning skills were developed when primary school pupils were taught with the use of ICT. It was observed that primary school teachers gave pupils the opportunity to present and define their own opinions, guided pupils to put parts together to form a whole and made judgments about their own opinions and information. They also helped them to determine the quality of their work based on a set of criteria and determined the validity of ideas in class as well as determined how the parts of information related to one another.

This validates research carried out by Serim and Koch (1996), who found out that, learners can direct their own learning when using the Internet and ICT. The Internet actively supports pupils' learning and higher order thinking by eliminating barriers to accessing information (Serim & Koch, 1996). Computers have the capacity to improve learner engagement and interactions in a multi-sensory form (Cooper & Brna, 2002). Cognitive tools are communication methods such as visualisation, metaphor, symbols and hypermedia or interactive interfaces and environment such as templates, data bases, simulation, games and collaborative media (Pakdaman-Savoji et al, 2019). Computer based cognitive tools are defined as knowledge representational tools that enhance the power of human being during thinking, problem solving and learning (Jonassen & Reeves, 1996: Jonassen, 1992).

It was also observed that primary school teachers help pupils in class by breaking down information in to component parts. They guide learners to make inferences and find evidence to support generalizations and determine motives or causes of information with pupils in class. This supports the assertion that the use of ICT as well as other teaching strategies has enabled learners to move to higher-order thinking and students have developed constructive thinking skills (Jonassen & Carr, 2000; Kearney & Treagust, 2001; Oliver & Hannafin, 2000). ICT tools provide opportunities for children to develop learning skills that are valued in primary school curriculum. Higher order thinking skills include problem solving, investigating, evaluating and analysing, critical and creative thinking skills, and communication skills. ICT can be used to enhance pupils' understanding and as a result increase the quality of learning.

Conclusions

Introducing a new technology in any learning situation requires a great deal of thought, planning and a good deal of developmental testing. The various pedagogical perspectives or learning theories are important in designing and interacting with educational technology. These theoretical perspectives include behaviorism, constructivism and cognitivism. Digital tools are inevitable and can improve on performance (Jonassen & Reeves, 1996). Technological cognitive tools have the potentials to open a path to constructivist learning and transferable knowledge in educational system dominated by routinized practice and reproduction of given information (Pakdaman-Savoji et al, 2019).

It is important for educators and researchers to have a good grasp of technology and its advantages. Learners' engagement with cognitive tools can promote meaningful learning and reflective thinking (Jonassen, 2000). A problem based collaborative learning environment can support learners to find solutions to problems (Erhan & Hasan, 2017). Using ICT to improve the teaching and learning process is the key for pedagogy-technology integration in primary schools. Salomon, et al (1991) argue that digital technologies as a cognitive tool allows learners to engage in cognitive processes that are of a higher order than the ones they would display without that partnership and that the individual's performance is assessed under conditions that allow them to stretch their cognitive muscles to the maximum. Teachers need to be equipped with the fundamentals of ICT tools and sufficient understanding on the integration of these tools in teaching and learning. Efforts can be oriented towards changing mind set and developing positive attitudes towards ICT application in teaching and learning. It is important to for teachers to understanding the changing role of the teacher from instructor to facilitator.

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