Effects of Computer Animation on Students' Learning Outcomes in Four Core Subjects in Basic Education in Abuja, Nigeria

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Abstract
The research was conducted to determine the effects of computer animation on pupils learning outcomes in four core subjects in basic education inAbuja, Nigeria. The study adopted the pretest-posttest control group quasi-experimental research design. The instruments for data collection for this study were Science and Technology Achievement Test (0.85) Mathematics Achievement Test (0.83), English Achievement Test (0.79), and Civic Education Achievement Test (0.73). Purposive sampling technique was used in selecting primary three pupils in two private primary schools in Abuja Municipal Area Council, 24 primary school pupils were then randomly assigned to one control and one experimental group. One research hypothesis was generated and tested, data collected were analyzed using mean, standard deviation and inferential statistics of Multivariate analysis of covariance (MANCOVA). Results revealed that the main effect of treatment on students' achievement in mathematics, English language, and civic education is not significant except in science $F_{(1,12)}= 13.64, p<0.05$*). Thereforethe use of animation-ish software should be employed in learning science and technology in primary schools.*

Keywords: Computer animation, Animation-ish software, Core subjects in Primary Education and Learning outcomes

Introduction

Primary education sets the base for learning difficult academic concepts; therefore, the effectiveness of higher education is determined by the strength of the primary education system (Olaniyan and Obadara, 2008). Products of this basic educational system are foot steps to the next level, hence the substance set here will go a long way to determine the quality and ability of learners at the secondary and tertiary levels of education. In the same vein, Jaiyeoba, (2011) discoursed that since the products from the primary level of education are the entrants into the secondary level, then the effects (whether positive or negative) could

be seen, not only at the secondary level but also at the higher education as well.

In the light of laying a solid foundation for primary learners, three of the objectives in the National Policy on Education (NPE) emphasise the following for primary education:

1. to lay a sound basis for scientific, critical and reflective thinking;
2. to develop the child's ability to adapt to his or her changing environment; and
3. to provide opportunities for the child to develop life manipulative skills that will enable the child to function effectively in the society within the limits of the child's capacity(NPE, 2013).

Unquestionably, the use of technology for teaching and learning has been proven to be fundamental and helpful in achieving these objectives; therefore, the National policy on Education mandates technology integration at all levels of education (NPE, 2013). In order to ensure a solid foundation at the basic level, NPE specifically encourages the use of technology for teaching and learning in primary education. Interestingly, the use of technology tools may not be a strange phenomenon to learners at this level because these young ones have begun to explore the opportunities that technology devices provide.

Primary school pupils are already interacting with these tools outside the classroom. They try their hands-on with mobile phones, computers, Ipads, laptops, the internet, and even social networks. That is why today's primary school learners are often referred to as digital natives because they are born into a world where they have daily contact with different types of technologies. However, the challenge arises when they get into the classroom and discover that there is a major disconnect between the school system and their environment. Aladejana (2013) reflected on this disconnect and described today's classrooms as a cycle of memorisation, repetition, and note-copying. He explained that these activities agree perfectly with the world in the past but now the world is increasingly shaped by Information and Communication Technology (ICT). ICT allows pupils to explore, observe, engage, solve problems and make exciting discoveries for themselves. It stimulates collaboration and interaction amongst peers and also between pupils and teachers. ICT resources not only provide the tools for promoting and

developing these skills but also encourages the pupils to engage confidently in imaginative learning and make teaching and learning more effective and fun for everyone involved.

ICT is now part of the primary school curriculum as "computer studies". It is expected that pupils should be able to identify the various parts of the computer, use and apply software (word processing), communicate (send and receive messages) and participate in other activities, such as playing games and watching educational films (NERDC, 2007).It is also expected that pupils should be able to set up and power a computer system. The curriculum was designed to make pupils aware of the capability of computers and give them the skills to manipulate them. However, while specific technical skills are certainly important for pupils to learn, they do not provide an adequate foundation for them to transfer and apply the skills in different situations. Pupils need to be directed and steered to see greater value in technology tools besides the entertainment benefits they derive from their use. According to Pitler (2006), "when applied effectively, technology not only increases students' learning, understanding, and achievement, but also augments their motivation to learn, encourages collaborative learning, and develops critical thinking and problem-solving strategies". All these skills and more, as listed by Pitler, are listed as 21st century skills. Stated in the NPE (2013) is the need for classrooms to be matched with the expectations of the 21st century world. It seems important, therefore, to ensure that young learners develop functional and transferrable skills in relation to the use of technology as well as guide them in making productive use of technology tools in the classroom (Hayes, Mary, Whitebread and David, 2006). This implies that it is important for learners to get the needed skills that will equip them for life outside school. It is necessary that at this formative stage of education, primary school pupils are adequately prepared for what the future holds in the next level of education and outside the classroom via the use of technology tools.

In line with using technology to harness constructive learning experiences, one of the tools which can be used to achieve this is Animation. Animation in teaching and learning combat boredom, having the capability of activating the senses of sight, hearing, and in the case of concrete objects,

the sense of touch (Isaac and EmaEma 2015). Studies conducted by Mayer and Chandler (2001) show that the knowledge level of students improved particularly text is added to diagrams. There are different types of animation software, the one used for the study is called Animation-ish.



Animation-ish software is an easy-to-use animation program that inspires creativity and allows primary school pupils to "show what they know." It sparks ingenuity and imagination; it provides engaging activities that integrate imagination across the curriculum; it helps teachers make exciting lesson content that are represented visually. Also, it boosts technology literacy skills and teaches basic concepts in animation and graphic design. Pupils can reconstruct learning experiences by creating their own animated content. This can more or less, be seen as reliving classroom learning experiences and this process may involve the combination of moving images, texts and/or sounds. According to Beckerman (2003), "there is no other graphic art that so stretches the imagination to get a laugh, display an abstraction, explain a method, or sell a product." Animation is a way of telling stories, as abstract or imaginative as they may be. One of the advantages of animation is the possibility to give abstract concepts a visual presentation. This is a key component of educational graphics. The visuals are there to support learning, and if the concept is best represented in motion, the potential of the digital platform can be used to its advantage. Animation can also explain complex things in the simplest ways, and open up new perspectives to the viewer. The viewer may not have been able to visually imagine what is explained in the material in text form, but a still infographic could help form the idea, and animation could push the realisation even further. Animation allows learners to engage in a high level of cognitive reasoning that goes past rote memorisation thereby leading to understanding and retention of the subject matter.

According to Swain (2012), students who studied with the use of animation apply three learning styles: visual, auditory and kinesthetic, and use three senses: seeing, hearing, and touching. In addition, a study by Barak, Ashkar, and Dori (2011) showed that the use of multi-senses for the construction of knowledge promotes meaningful learning. These features mentioned above result in permanent learning as well as engaging learners' higher-order thinking skills (Kayaoglu, Dag Akbas and Özturk, 2011).

Like most technology tools used in the classroom, using animation in the classroom can be viewed from two different perspectives. First, it enables the creation of mental representations of concepts, phenomenon, and processes. Second, it can be used to support challenging cognitive processes such as abstraction, imagination, or creativity, which some learners are short of (Barak, Ashkar, and Dori, 2011). Kafai, (2006) viewed it as a situation where children are supported to become "producers" rather than "consumers". Instead of merely reading textbooks and solving workbook problems, students can redefine the content or subject matter that they encounter by reconstructing their knowledge to solve problems and represent their solution in animated form. This can mean that they learn, digest and create out of what they have originally learned instead of only regurgitating. This deep learning process will, in the long run, lead to increased learning outcomes besides other skills that learners can acquire. In other words, creating animations in the classroom will help learners to visually represent what they are studying, arrive at a deeper understanding of learning concepts and commit what they are learning to memory.

According to Cameron and Tanti (2011), the advent of web 2.0 tools have made it easier to provide students with the opportunity to contribute to their own learning. Recent advances in technology have led to the development of software that can be used for creating animations for a wide range of instructions. Some of these animation tools are simple, easy to manipulate and use while others are much more complex and require advanced skills. This study builds on past research efforts that the use of animations for creating content by learners can be used as an excellent tool for improving learners' achievement across subjects in primary schools. This research seeks to determine whether the use of animation will be an

effective after-school technology tool for helping pupils better understand subjects while enhancing their classroom learning experiences. Specifically, learning outcomes will be assessed across four core subjects (Mathematics, English, Civics, and Science) at the primary education level.

In this study, the use of animation for design by pupils was in the form of an extended school day activity. Extended school learning programmes, popularly referred to as "after-school" programmes are typically described as safe, structured programmes that offer an array of adult-supervised activities to promote the learning and development of pupils and students between kindergarten and high school outside of the school day (Beckett, Borman, Capizzano, Parsley, Ross, Schirm, and Taylor, 2009; Harvard Family Research Project, 2008; and Lauer, Akiba, Wilkerson, Apthorp, Snow, and Martin-Glenn, 2004). When compared to the school day activities, these programmes tend to have smaller groups and less-formal settings which provide opportunities for young people to interact and share among themselves. A review of the literature suggests that after-school programmes can serve four major functions: (a) increase safety and supervision, (b) enhance cultural and community identification and appreciation, (c) develop social skills and increased competency, and (d) improve academic achievement (Cosden, Morrison, Albanese, and Macias, 2001). A growing number of studies and evaluations (Shernoff 2010; Huang, Leon, Harven, La Torre and Mostafavi, 2009; Fredricks and Eccles 2006; Darling, 2005) have shown the positive impact of after-school programmes on students' learning outcomes. After-school programmes take different forms and are structured to meet particular needs. They vary considerably in terms of the goals they set for attendees and in the outcomes they expect and achieve (Cosden, Morrison, Albanese, and Macias, 2001).

According to Shumow (2001), after-school programmes vary in terms of their philosophy, goals, and programming. Some of these programmes are structured to provide recreational activities; others focus on academics by providing tutoring in school subjects and assisting with homework completion. Still, other programmes centre on providing children with opportunities to develop skills and interests in activities such as dance, music, science, or arts and crafts (Shumow, 2001). This study will focus on improving learning

outcomes by providing enriching after-school learning environments where primary pupils can create animations of concepts that were learned during school hours. This after-school activity seeks to provide hands-on experiences in a technology-based environment which will make class lessons more meaningful to learners.

Several factors have been highlighted to affect learners' achievement in a technology-based classroom. Learners' technology skill is an important factor when using technology for teaching and learning. Learners are likely to have technology entry skills that can foster or inhibit learning in a technology-based classroom environment. For example, studies by (Bulfin and North 2007; OECD, 2006; Liu, 2003; Papanastasiou, Zembylas and Vrasidas, 2003) revealed that student's competence with multimedia tools was also reflected in the programmes they created. Furthermore, these studies showed that students' experience in the use of the multimedia tool was more self-directed and the pupils were more ready to apply their skills than novices. This could mean that learners with prior technology skills may have greater confidence and technology knowledge than novices. In addition, learner's technology skills can be dependent on some home-based factors like access to computers. In today's technology-increasingly -dependent world, various technology devices have penetrated our homes and most families have one form of technology device or the other. From the foregoing, it is likely that learners who have some prior computer skills may be more engaged in the design process than greenhorns. It may also affect their learning outcomes in core subjects or technology skills that may be acquired during the design process.

According to the findings of Aksoy (2012), who examined the effect of animation technique on the 7th Grade Science and Technology Course, it was reported that animation technique is more effective than traditional teaching methods in terms of enhancing students' achievement. Also, Dziedzic, Barszcz, Paśnikowska-Łukaszuk and Jankowska (2015), in discussing the role of computer animation in teaching technical subjects, found out that in the teaching process, computer animation has a positive effect on memorization of knowledge by students. Use of computer animations together with teaching methods and techniques and having the students actively participate in the process ensure the

provision of effective and efficient education (Daşdemir and Doymuş, 2012; Karaçöp, 2010). Therefore, the purpose of this study is to determine the effects of computer animation techniques on pupils' learning outcomes in four core subjects (Mathematics, English, Civics, and Science) in primary three.

Hypothesis

There is no significant main effect of treatment on pupils' achievement in four core primary school subjects (Mathematics, English language, Civic education, and Basic Science and Technology)

Methodology

The study adopted the pretest-posttest control group quasi-experimental research design. The population for the study was all primary three pupils in private primary schools in Abuja Municipal Area Council. The two schools for this study were selected using a purposive sampling technique. The criteria for selection are: pupils that were not special pupils (handicapped or disabled), the school must have a regular class and an intact population of not below twenty (20) pupils; and should have at least eight computers that are functional. Twenty-four primary three pupils were randomly sampled and assigned to the experimental and control group. The instruments for data collection for this study were Science and Technology Achievement Test (0.85), Mathematics Achievement Test (0.83), English Achievement Test (0.73), and Civic Education Achievement Test (079).

Pretests were administered to experimental and control groups to determine their entry achievement. Pupils in the experimental group were trained to use the Animation-ish software for designing animations and apply them to topics in core subjects. Having learned to use the tool, pupils begin to engage in the design and creation of their own animation based on a chosen core subject for the day. The intervention lasted twelve weeks and the class was scheduled to hold twice a week. Each meeting took place for forty minutes (the length of a regular class period). The control group went through normal school classes and their regular after school lessons. Post-tests were conducted for the two groups.

The data collected were analysedusing mean, standard deviation and inferential statistics of Multivariate analysis of covariance (MANCOVA).

Results

Table 1: Effects of Treatment on Student s' Achievement in Mathematics, English Language, Civil and Sciences

Variable	subject	Mean ± SD	F	Sig
Treatment	Math	17.773± 0.388	0.697	0.1600
	Eng	17.179 ± 0.327	0.012	0.9140
	Civic	17.982 ± 0.253	0.537	0.4030
	Science	17.982± 0.288	13.64	0.0030*

*Sig. at p <0.05

Table 1 revealed that the main effect of treatment on pupils' achievement in Mathematics, English language, and Civic education is not significant except in science ($F_{(1,12)}$= 13.64, p<0.05). This implies that the use of animation-ish software for creating animation is effective on pupils in the area of science-learning but has no effect on other aspects tested in the study

Table 2: Estimated Marginal Means of posts test achievement score in four core subjects

Dependent Variable	Treatment	Mean	Std. Error	95% Confidence Interval	
				Lower Bound	Upper Bound
Postmaths	Control	17.556[a]	.405	16.673	18.439
	treatment	17.773[a]	.388	16.927	18.619
Postenglish	Control	17.230[a]	.341	16.487	17.974
	treatment	17.179[a]	.327	16.467	17.892
Postcivics	Control	17.757[a]	.264	17.182	18.332
	treatment	17.982[a]	.253	17.431	18.533
Postscience	Control	16.626[a]	.300	15.971	17.280
	treatment	18.115[a]	.288	17.488	18.742

Covariates appearing in the model are evaluated at the following values: premaths = 16.9167, preenglish = 16.3333, precivics = 17.3750, prescience = 16.6667.

Table 2 indicates that theposttest mean score of pupils in science exposed to animation-ish software is higher ($\bar{x}$=18.12) than their counterparts in the control group ($\bar{x}$=16.64). This difference in their mean scores is significant. Hence, animation-ish made pupils do better in science. It was also revealed that the posttest mean score of pupils in mathematics exposed to the animation-ish software is higher ($\bar{x}$=17.77) than those in the control group ($\bar{x}$=17.56). This difference in mean scores is not significant. Hence the performance of students exposed to animation-ish and control groups respectively in mathematics is not different from each other. The posttest mean score of pupils in English in the control group is higher ($\bar{x}$=17.23) than their counterparts in the animation-ish software group ($\bar{x}$=17.20). This difference in mean scores is not significant. This means that the performance of pupils exposed to the animation-ish and the control respectively in English is not different from each other. The posttest performance of pupils exposed to the animation-ish software in civics is higher ($\bar{x}$=17.98) than those in the control group ($\bar{x}$=17.76). This means that the difference in their mean scores is not significant. Hence the performance of pupils in civics in the animation-ish and the control respectively in civics is not different from each other. It could be inferred that animation-ish software is effective than the control in enhancing pupils 'achievement in science but there is no difference in the achievement of pupils in civics, mathematics, and English exposed to animation-ish software and control respectively.

Discussion

The findings of this study have shown that the use of animation-ish software has produced significant results in science. This implies that the process of animation creation using animation-ish software is more effective on the conceptspupils learned in science.It was observed that participants exposed to animation-ish performed significantly better than those in the control group (conventional method of teaching). The effectiveness of animation-ish software could be attributed to the fact that the use of animation can turn the pupils into active participants and co-producers of knowledge and enhance the learning abilities of pupils. This correlates with the findings of Shreesha and Tyagi (2016) that animation content helped the students to have proper visualization on complex science topics and

catchy tunes enabled them to register the keywords, concepts in students' mind easily, which helped them to memorize in a better way. This is in line with the findings of Barak, Ashkar, and Dori (2011) that the usage of multi-senses for the construction of knowledge, promotes meaningful learning. It is in agreement with Chan and Norlizah (2017) that new teaching approaches should beencouraged, that is, animation creation allows students to active participants and co-producers of knowledge and increase the learning abilities of students. The provision of appropriate resources and editing tools paves the way for students' motivation and it maximises its positive effect (Sadik, 2008).

This is in agreement with Daşdemir and Doymus (2012) and Karaçöp (2010) in their separate studies that the use of computer animations and simulations has a significant effect in teaching the abstract topics of science and technology courses. The use of computer animations with teaching methods and techniques and having the students actively participate in the process ensure the provision of effective and efficient education. The results also agreed with the findings of Daves (2011) that learning is enhanced through the use of technology and students need to develop technology skills in order to be productive members of society.

The following observations were also made from the study:

1. It took much longer than expected for learners to understand the tools of the animation software and so between the third and fourth week, pupils were still trying to have a proper grasp of the tool before they could commence relating it to classroom concepts.
2. The above raises a concern about whether the software was a bit advanced for the participants at the basic level. Hence, the participants in the main study may be raised to the middle basic education level.
3. Children worked faster when they worked individually than in groups because it gave each child the opportunity to focus on a project at hand.
4. Despite the fact that learners worked in groups, they still wanted to be able to move around the class and see what each person was working on and from time to time, they liked to ask questions from friends when they encountered difficulty.

5. The more participants worked with the software, the easier it was for them subsequently.
6. Learners took time conceptualising projects and deciding what form the object(s) on each frame should take.
7. There is a need to incorporate brief teaching on how learners can create their own storyboard. A proper storyboard prior to starting the animation will make learners have a full picture of the end from the beginning which will also make the animation process easier.
8. A structured approach was followed which constrained participants to use only the animation tools they were exposed to. Some learners wanted to explore other tools; this showed creativity. Participants can be allowed to explore other tools as they gain mastery of the animation software.

Conclusion and Recommendations

Since the goal of the primary education system is to foster 21stcentury skills which will be a base for secondary and tertiary education to build upon, we need to engage pupils in creating their own learning experience. To achieve this, there is a need to engage them in the learning process through the use of ICT. Knowing that ICT can be used as a tool to teach and as a tool to create, there is the need to focus more on the latter which, according to the findings, has produced a positive result in bringing about improved performance and greater retention of the content the pupil created the animation on especially in science. This has shown animation through the use ofanimation-ish software as an important tool that fosters creativity in learners and which in turn brings about greater academic achievements in learning science.

In light of the findings in this study, it is recommended that primary school educators should engage pupils in the use of ICT tools so as to help them to createa learning experience for themselves. Also, since creation or animation that is based on learned content produced improved retention and achievement, therefore, animation-ish software should be employed in schools and be used by pupils in learning science and technology. The teachers should be trained on how to use the animation-ish software as well as guide students to use the software.

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