



Effect of the Use of Multimedia on Students' Performance in Secondary School Mathematics

Oyebola Akinoso*

Faculty of Education, Department of Science and Technology Education, University of Lagos, Nigeria

*Corresponding author: Oyebola Akinoso, Faculty of Education, Department of Science and Technology Education, University of Lagos, Nigeria, Tel: +2348035041573; E-mail: oye_akinoso@yahoo.com

Received date: May 02, 2018; Accepted date: May 10, 2018; Published date: May 17, 2018

Copyright: © 2018 Akinoso O. This is an open-access article distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.

Citation: Akinoso O. Effect of the Use of Multimedia on Students' Performance in Secondary School Mathematics. Global Media Journal 2018, 16:30.

Abstract

The research investigates effectiveness of multimedia on students' performance in mathematics. Two schools were randomly selected from Educational District V. Intact classes were purposely assigned into experimental and control. Quasi experimental design was adopted. Mathematics Achievement Test with reliability coefficient of 0.81 using KR-20 was used. Data collected were analyzed using ANCOVA. No significant effect exists between the Treatment and achievement in mathematics, the mean achievement score of experimental group was higher than that of control. Also, significant effect did not exist on treatment and gender, but, male have higher achievement mean score ($\bar{x} = 57.50$) than female counterparts ($\bar{x} = 54.13$). Multimedia positively influenced the academic performance of students in mathematics.

Keywords: Multimedia; Information communication technology; Performance in mathematics; Secondary school mathematics

Introduction

Today's world is dominated by the use of Information and Communication Technology (ICT). Communication this day is so easy to the extent that any part of the world can be reached and discuss any issue at any point in time, this implies that the world has being reduced to a concise size through information and communication technology thus, information communication technology ensures national development through adequate communication to seek for opinion in any other country which brings deep relationship with other nations. Information communication technology can be categorized to Information Technology (IT) and Communication Technology (CT) [1]. Information communication technology comprises of technologies for manipulative communication of information and also consists

of the medium for information recording like radio, television, and others, and technology for communication through voice and sound or images using microphone, camera, loudspeaker, and telephone/mobile phones [2]. Information communication technology is indispensable when considering its importance in the industrialized societies. The use of information communication technology can be seen as an added advantage which creates suitable environment to the educational system. This might be the reason why Ololube [3] stated that information communication technology gives a new phase to the education system in terms of pedagogical approach.

According to studies [4], information communication technology facilities are described as all available facilities for the identification, generation, processing, storage, packaging, preservation, conservation and transfer of information, in which time and distance is not constraints. In other words, information communication technology is an information handling tools which can be used for producing, storing, processing, distributing and exchanging information. Information communication technology has become a powerful tool for participating in global markets, promoting political accountability, improving the delivery of basic services and enhancing local development opportunities (United Nations Development Programme, 2006). Akinoso et al. [5] stated that, the technology serves as an important function beyond satisfying intellectual curiosity. Akinoso, Agoro & Alabi further stated that the availability of powerful, globally-connected computers or integration of information and communication technology alone is not sufficient to insure that students learn, there are some other things to put into consideration, the use of this tool i.e whether the teachers are using the tools or not, adequate knowledge of how to use the tool and when to use it especially for the subjects that pose conceptual difficulties such as mathematics and science. The National Policy on Education stated that education is an important tool for national development [6]. This makes the incorporation of ICT into teaching-learning process vital. To buttress this, Galenouh, Gordlier and Murphy, opined that the development and role of information and communication technology in educational sector is believed to set the pace for

innovation and changes that happens to any nation. It is not only engineers but everybody needs to be entrepreneurial in order to understand and contribute in the context of information and communication technology market and business pressures. It was asserted by Albirini [7] that information and communication technology is to be programmed towards meeting the set educational goals. Thus, it has become a compulsory issue for experienced mathematics teachers to be confident in using information and communication technology effectively in teaching [8]. Wirsiy and Shafack in Bappah [9] defined information and communication technology as a broad based term that encompasses the gathering, organization, storage and retrieval of information that can be in textual or numerical, pictorial and vocal forms or a combination of all (multi-media), using a combination of computers and telecommunications telephony distance learning.

Multimedia devices as part of information and communication technology facilities which are electronic media devices used to store and experience multimedia content. Multimedia is concerned with the computer-controlled integration of text, graphics, drawings, still and moving images (video), animation, audio and any other media where every type of information can be represented, stored, transmitted and processed digitally. Multimedia is all about communicating in several ways. Multimedia is used in several fields such as advertising and marketing, education and training sector and mass communication (journalism). Multimedia items generally fall into one of five main categories and use varied techniques for digital formatting such as text, images, audio, video and animation. With the advancement of technology in this world, this has made the world changing rapidly which is affecting the educational field positively. The information and communication technology has drastically changed the classroom learning environment that can attract the interest of students and make student active during lesson unlike passive environment which cannot help in learning and retention. The use of multimedia in education precisely mathematics education is increasing and will continue to increase in the field of learning due to the digital age. Teachers need these resources in order to make teaching easy, to bring into reality through the concept taught and help the student understanding. The benefits derived from the use of multimedia resources is not limited to the ease of teachers work alone especially to support constructive concept development, but help students in such a way that make them relate the knowledge to real life. By enabling teacher to have access in multimedia learning resource, which helps to support constructive concept development, this helps the teacher to be more focus to teaching the subject and help the students to have thorough understanding of the concept. The multimedia also help to ease learning, by enabling students to learn at home which improve student learning skills. Multimedia elements, which include text, graphic, video, sound and animation, help creation of an interactive learning environment that can help teacher and students teaching and learning. It encourages deep reflective thinking.

Mathematics can be defined as the science of numbers, quantity and space of which arithmetic, algebra, trigonometry and geometry are branches, according to Oxford Advanced Learner's Dictionary of Current English. It is defined by Pickover [10] as the loom upon which God weaves the fabric of the universal, the science of patterns, a conducting thread connecting scientific ideas with the understanding of our environment and a formal system of taught for recognizing, classifying and exploiting patterns developed by the human mind and culture. Sigh [11] emphasized that mathematics is the king of other subjects and, therefore, pivotal to development in such areas as economy, culture and policies. In order to raise safer and better people in life, more emphases must be laid on how to get more knowledge of mathematics to be able to apply the knowledge in solving real life problems [12]. She emphasized further that, the goal of education is to equip people to lead meaningful lives which is surely the basic contribution of mathematics, apart from making a living, a safe life full of joy, peace, free from all kinds of crisis, unnecessary aggression, kidnapping and rape.

The National Policy on Education (NPE) stipulated that mathematics should be one of the core subjects taught at primary and secondary schools, due to its importance in the area of science and technology. Its objectives are stated: to inculcate permanent literacy and numeracy and ability to communicate effectively and to lay sound basis for scientific and reflective thinking [6]. Mathematics, due to its importance is a compulsory subject for all primary and post primary schools in many countries of the world. The expectation is that, adequate exposure of students to the knowledge of mathematics will facilitate their achievement not only in mathematics but also in other areas of human endeavors Odogwu [13]. In this volatile, uncertain, complex and ambiguous (VUCA) world, the teaching of mathematics should be handled with care, since it is all about solving problems both mathematical and real life problems Akinoso [14]. Mathematics is widely used in the following area

Usefulness of mathematics in everyday life in keeping of records, four basic operations of addition, subtraction, multiplication and division as carried out on numbers, money, length, mass, time and other objects as they occur in everyday life. Shopping lists as prepared before buying, estimations and actual measurement of lengths, distance, volume, time made at home, market and other public places, keeping appointments, dialing numbers on mobile phones which are carried out on daily basis.

Usefulness of mathematics in vocations or apprenticeship such as carpentry, bricklaying, battery charging, tailoring, welding, plumbing which needs basic understanding of geometry involving plane shapes, three dimensional solids, symmetry, angles and measurement. Use of calculators by business men and women in small and big business.

Usefulness of mathematics in other school subjects such as Geography, Sciences, English, Economic, Accounts/book-keeping. In geography, students need mathematics to calculate gradients, population density, longitude and latitude. Mathematical concepts of proportion and graphs are needed

in economics classes in a topic like demand and supply. Even subjects like English apply mathematical concepts when students have to count the number of words in an essay. In sciences, such words like roots, exponent, vector and power. The application of mathematics to school subjects supports its retention as core subject at the secondary school level.

Mathematics is very useful in different professions. Almost all universities require a credit at the senior secondary school for admission irrespective of the course or profession. This underscores the significance of mathematics to various professions. The historian applies mathematical concepts to process his information, keep his records straight and sequential. Dates of historical event are most meaningful and precise when they are recorded using mathematical concepts. Mathematics aids the accountant in keeping his records brief, accurate, straight, logical and sequential. The accountant is able to present his data pictorially and concisely using pie charts, bar charts, histograms and many other mathematical presentations. The banker uses the principle of simple interest and compound interest to update and balance accounts on daily, weekly, monthly, quarterly and yearly basis on individual and cooperate accounts in the bank. The engineer cannot function effectively without applying mathematics. Psychologists use mathematics to build learning models. Social sciences are using probability and game theory to study politics and crime. Economics as a branch called econometrics which applies substantial mathematical concepts.

Mathematical analysis has also been applied in the study of language and literature by linguists. Computer, which has revolutionized the whole world, is applied mathematics. The geologist in locating oil reserves has found mathematics indispensable. Mathematics is proving to be more useful to the sciences, the humanities and even in arts in this era. In government, mathematics is needed to plan, prepare budgets and keep record of income and expenditure. There is striking application of mathematics to the entire landscape of natural, behavioral and social sciences. All advances in design, control and efficiency of modern airlines depend on sophisticated mathematical models that simulate performance before prototypes are built. From CAT scanner in medical technology to genetics in the decoding of DNA all apply one mathematical concept or the other. Mathematics has made an indelible print on modern science even as it has stimulated the growth of many branches of science. In summary, mathematics is very vital in other discipline.

Also, the academic achievement of students in Nigeria has been a source of concern to researchers, educators, government and parents. Obviously, the great importance that mathematics has on the national development of the country made it so important and this cannot just be overlooked. Research report indicated a consensus of opinion about the fallen standard of education in Nigeria [15]. The factors that contribute to the poor performance of students in mathematics according to Mbugua [16] include socio-cultural factors: students' factors-entry behavior motivation and attitude, socio-economic factors: education of parents and the economic status, school based factors: availability and usage of

teaching and learning facilities, school type and teacher characteristics, method of teaching mathematics, effectiveness of mathematics teacher, teachers' workload, teachers' attitude towards mathematics. The strategy for teaching a mathematics concept according to Odogwu [13] is the procedure, process and the algorithm used to deal with the concept. The strategy a teacher chooses will depend on the nature of the topic, the class of the students and the overall objectives of the curriculum. According to Akinoso [14] the use of concrete-representational instructional strategy can help students to learn any concept in mathematics in an active manner and allow the use of real life materials that can be visualized.

The world of today promotes gender equity by improving access to education especially to females through girl-child education programs. Gender gap exists in education in sub-Saharan Africa, and out-of-school children, more of whom are girls, are deprived of any opportunity to gain ICT related knowledge and skill in school. African girls have the lowest enrolment rates in the world of science and technology education at all levels. Studies had established that females tend to be less interested in computer and use them less often in their spare time [17]. A study conducted in four African countries identified that while in principles, girls are given the same opportunity as boys of access to computer, gender equity does not exist in practice. It established that girls are less confident than boys in their computer skills, and that some international studies have found that boys scored better than girls in computer related knowledge and skills in vast majority of countries. In addition, the three computer related occupation (computer scientists, computer engineers and system analysts, and computer science and engineering) are the top career choices for boys [18]. The findings of Idowu, Adagunodo and Idowu [19] in study of gender differences in computer literacy showed that there is gender difference in computer study and experience.

Tomte and Hatlevik [20] pointed out factors such as: access to the use of internet, community, parents' influence, peer influence, social media, gaming, responsible for the difference in gender in the use of ICT. Abdul-Raheem found no significant difference in achievement of male and female students in mathematics. Contrary to the findings of Schumacher and Martin [21] showing that female are less experienced with ICT's and are more likely than males to have negative attitudes towards computers. Further-more, male students prefer to study courses that require computer use more than female students and they show interest in programming and games playing. They were also more experience at the ICT's use than girls, apart from e-mails where no significant differences were reported. Moreover, Colley and Comber [22] in their study on age and gender difference in computer use and attitudes among secondary school students found out that boys have higher frequency of use of computers than girls. The study carried out by Anyamene et al., [23] on the effect of Computer Assisted Instruction (CAI) packages on the performance of senior secondary students in mathematics, history and physics respectively revealed that no significant difference exist in the post test performance scores of male and female students

taught using this package. The findings of Bressers and Bergen suggested that male college student internet users spend more time online than female college student internet users. Jackson [24] emphasized that “masculinist ideologies of mastery and control” have strongly and consistently informed technological innovation.

Review of Literature

The Chalk and talk method of teaching which involve too much conversation in teaching has lost its efficacy and student’s interest in subject. From online free teaching, it was stated that the advancement in instructional and has strongly influenced the field of education. It was discovered that teaching and learning are being influenced by a number of new media such as interaction between the students and programmed instruction that give room for manipulation which might not be possible by using any other medium. Students can learn new information due to multimedia provision of easiness and facilities in education. Semerci [25] expressed the fact that the message via multimedia reaches the receivers in various ways, this provides enablement learning environment. The subjects being taught could be transmitted to the students with web-based audio, visuals, video and animations in a way that might not be taught in classrooms with other techniques. Students can gain the knowledge and information that would not be able to get from other ways of teaching, besides students could have the opportunity to prepare their own products with multimedia technique. With that information, it could be asserted that the use of multimedia helps students with different skills and learning styles.

The impact of the use of multimedia on students’ learning is two folds: the enormous and easy availability of textual and audio visual content to be used for teaching can make lessons more complete and attractive; then self-production of content that information and communication technology offer can help teachers customize the teaching more effectively. In an evaluation of the “Laptops for teachers” program of the British Government (2004-2007), teachers who had been equipped with a laptop report having extended their capacity to access resources and save time for lesson planning and preparation [26]. The use of multimedia might affects education positively when designed properly compared to traditional instruction in terms of academic achievement [27]. By considering the facts gathered from the literature, it could be asserted that multimedia apart from ease and objectifies learning, it makes the learner active and each and every one of them contribute their quota and making learning of mathematics more interesting.

The Behaviorist Theory

According to McLeod [28], the behaviourist approach is only concerned with observable stimulus-response behaviours, and stated that all behaviours are learned through environmental interaction. Behaviourism emphasizes the role of environmental factors in influencing behaviour, to the near

exclusion of innate or inherited factors. This amounts essentially to a focus on learning. New things can be learnt through 'learning theory and behaviors, no matter how complex, can be reduced to a simple stimulus-response association. Watson [29] described the purpose of psychology as: 'to predict, given the stimulus, what reaction will take place; or, given the reaction, state what the situation or stimulus is that has caused the reaction. This theory is relevant to this study especially to the learning of mathematics which required enablement environment and real-life materials to interact with to reduce the abstract level and to simplify the complexity of the subject.

Statement of the Problem

The world today is changing at a fast rate, so also the various sectors in the development of a nation. Education being one of these sectors and in fact, the instrument per excellence for national development also moves along within this line. Ways of improving the teaching and learning of mathematics should be a great concern of the education stakeholder due to its benefits to the society. The use of multimedia might play a tangible role in this area. This study therefore focuses on students’ performance in senior secondary mathematics and seeks to find out if there exist any difference in the performance of the students taught mathematics using multimedia materials and those taught mathematics without using multimedia.

Purpose of the Study

This study investigates the effects of multimedia on students’ performance in senior secondary school mathematics. The study also aims at achieving the following objectives:

- To investigate the effects of multimedia on students’ performance in senior secondary mathematics.
- To investigate the influence of gender on students’ performance when taught using multimedia.
- To investigate the interaction effect of multimedia and gender difference on students’ academic performance.

Research Hypotheses

- The following null hypotheses were tested at 0.05 level of significance.
- HO1: No significant difference exist between the mean achievement scores of experimental and control.
- HO2: No significant difference between the mean achievement scores based on gender.
- HO3: There is no significant interaction effect of treatment on gender on students’ academic performance.

Scope of the Study

The study covers all the secondary schools in Lagos State. It also covered the following topics: logarithm, percentage error,

calculation of range, variance and standard deviation and circle theorems. The multimedia materials used are computer, calculator, microphone, speaker and CD-ROMS.

Methodology

Research design is concerned with the fundamental question of how the subject matter of a study is brought into the scope of the research and how they will be employed within the research setting to yield the required data. It is a model of proof that allows the researcher to draw inferences concerning relationships among two or more variables under study or investigations. The pre-test, post-test control group quasi experimental design was used for this study. The population of this study comprises of senior secondary school II in Lagos State. The sample used comprised 60 senior secondary school II students. The sample was selected from two different schools one for experimental and one for control. The instrument used is Mathematics Achievement Test (MAT) which contains twenty- five questions. The MAT questions were from four selected topics in Mathematics: logarithm, percentage error, range, variance and standard deviation and circle theorems.

The reliability testing of the instrument using KR-20 was 0.83 which shows that the instrument was reliable. The pre-test and post-test results were scored over one hundred (100) each. Four marks were awarded to each correct answer in the Mathematics Achievement Test (MAT). Data collected were analyzed using Analysis of Covariance (ANCOVA). This was used to test the three null hypotheses stated.

Results

From **Table 1**, the mean score for the experimental group ($\bar{x} = 59.80$) is greater than control ($\bar{x} = 52.79$).

Table 1: Estimated Marginal Means for the Experimental and Control Groups.

Group	Mean	Std. Dev.
Exp.	59.8	4.63
Control	52.79	4.5
Grand Mean: 56.20		

Table 2: Gender and the Mean Scores.

Gender	Mean	Std. dev.	N
Male	57.5	22.9	24
Female	54.13	20.11	15
Total	56.2	21.66	39
Grand Mean: 56.20			

Table 2 shows that the male students have higher mean score ($\bar{x} = 57.50$) than their female counterparts score ($\bar{x} = 54.13$).

H01: There is no significant difference between the mean achievement scores of experimental and control.

Table 3: Summary of ANCOVA of Post-test Achievement Scores by Treatment.

Source	Sum of sq.	df	Mean sq	F	Sig.
Corrected M.	5262.35	2	2631.18	7.54	0
Intercept	3902.31	1	3902.31	11.19	0
Pre test	2631.61	1	2631.61	7.54	0.01
Treatment	360.36	1	360.36	1.03	0.32
Error	12560.01	36	348.89		
Total	141024	39			
CorrectedTotal	17822.36	38			
R. squared	0.29				
Adjusted Rsq.	0.26				
Sig. at p<0.05					

From **Table 3**, treatment has no significant effect on students' achievement in mathematics. The implication is that, there is no significant difference in mathematics achievement of students exposed to multimedia materials and those in control, though the means are different, hypothesis one is hereby not rejected.

H02: There is no significant difference between the mean achievement scores of male and female students taught mathematics using multimedia materials.

Table 4: Interactive Effect of Treatment and Gender on Dependent Variable.

Source	Sum of sq.	df	Mean sq.	F	Sig.
Corr. Mod.	5264.16	4	1316.04	3.56	0.16
Intercept	3845.01	1	3845.01	10.41	0
Pretest	2626.26	1	2626.26	7.11	0.01
Gender	0.8	1	0.8	0	0.96
Treatmt	337.61	1	337.61	0.91	0.35
Gender*Treatmt	1.28	1	1.28	0	0.95
Error	12558.2	34	369.36		
Total	141024	39			
Corrected Tot.	17822.36	38			
R2=.29 (Adjusted R2=.21)					

Table 4 below provided answer to solution to this null hypothesis.

Table 4 shows that, treatment has no significant effect on gender; hypothesis 2 is therefore not rejected. This implies that, treatment has no significant influence on gender.

HO3: There is no significant interaction effect of treatment on gender on students' academic performance.

Table 4 provides solution to the null hypothesis 3. It was discovered that the interaction effect of treatment on gender is not significant.

Discussion

Based on the findings of this study on the effect of multimedia on the academic performance of students, the difference occurs between the performance of students in experimental and control groups. The students in experimental group had higher mean achievement than those in control. In other words multimedia aids the teaching of mathematics than the traditional instruction. Additionally, students' interest, motivation and participation increased according to the researcher and experimental group's teacher observations. In control group, on the other hand, traditional instruction had less effect on the academic performance of the students. This implies that the present of different materials for learning influence the learning environment which serves as additional advantage to the teaching of mathematics in an active way. It has been concluded that students in the control had difficulties in concretization of abstract topics and this made their learning process not that encouraging. The materials used in the experimental group were more attention catching and enjoyable than the ones used in the control group. For the experimental group, it has been observed that all students were active in the learning process which is not so in control group. The multimedia use improves the learning mathematics. Though the mean of experimental group was higher than that of control group in this study but the difference was not significant.

Some studies indicated the use of multimedia and technology positively affects students' attitude, motivation and attention towards the lesson. In the study where the effect of multimedia technique on students' academic success was analyzed, no significant difference exist between the experimental and control groups in the web-based studies of Karadeniz and Akpınar [30]. The situation is also in parallel with Şahin, Akbaba and Çoruk and Çakir [31-33] studies. Şahin [31] stated that students who were instructed with multimedia are more successful compared to students instructed in traditional ways which is in line with the result of this study. Akbaba [32] reached similar results, he asserted the academic success level of the classroom using multimedia was higher than the classroom which did not use. In Çoruk and Çakir [33] study, "The Effect of Multimedia on Primary School Students on Academic Achievement and anxiety" there was no difference in the result. They highlighted that multimedia increases student success. In all three studies, it has been indicated that instructions with multimedia use increased student achievement. Arici and Yekta [34], on the other hand, found no significant difference between but found multimedia as neutral effective on the academic achievement of the students.

Akin and Çeçen [35] observed that student motivation increased after the implementation of multimedia in the study. It has been found in research that the use of multimedia in the learning process does not only increase success level of the students but create positive changes in the attitudes of the students towards lessons. Akbaba et al. [32] stated the use of multimedia positively affects 7th grade students' attitude towards social studies lesson. In the same sense, Yünkül and Er [36] found students' attitudes towards lesson were positively affected by the use of multimedia as the students in the experimental group. However, Altinişik and Orhan [37] found reverse results as having no significant difference in the results. Altinişik and Orhan explained the reason of this non-difference situation as it was students' first experience of multimedia use and time limitation. Moreover, Aytan and Başal [38] found teacher attitude towards web 2.0 tools were positive, these tools improve critical thinking and ICT skills, information exchange feedback process in their study web 2.0 tools effects were investigated. Tomte [20] pointed out factors such as: access to the use of internet, community, parents' influence, peer influence, social media, gaming etc., are responsible for gender difference in the use of ICT. Abdul-Raheem [39] revealed that there is no significant difference between the mean achievement of male and female students in both experimental and control group; this was also in agreement with the findings of this study. The study carried out by Anyamene [23] on the effect of CAI packages on the performance of senior secondary students in mathematics, history and physics respectively revealed that there was no significant difference in the test performance scores of male and female students taught using CAI packages.

Conclusion

According to the results of this study, it was established that the use of multimedia can improve the learning of mathematics to a certain level. The experimental group mean was higher than the control, but the difference was not significant. Also, there was no significant difference on achievement using multimedia materials based on gender, but male was of higher mean score than female. In conclusion, multimedia technique increased the academic success of students in mathematics to a certain level.

Recommendations

The following recommendations were made:

- The teachers of mathematics must have adequate knowledge of computer to be able to carry out the teaching of the subject with the use of multimedia therefore; in-service training should be attended to upgrade their knowledge from time to time.
- Materials with today's technology for mathematics lesson should be chosen and developed.
- The technological groundwork of the schools should be improved and schools should be designed in a way to present opportunities for multimedia use.

- Multimedia-aided teaching moves us towards the constructivist approach of learning in which learners plays an active role, so teachers should be encouraged to teach mathematics using multimedia.

References

- Iwu AO, Ike GA (2009) Information and communication technology and Programmed Instruction for the attainment of educational goals in Nigeria's econdary schools. *Journal of the Nigeria Association for educational media and technology (I)*.
- Osu SR, Udosen IR, Akpan BP (2010) Resources Availability and Level of Preparedness of Biology Teachers. *J ournal of Education Research and Policies* 5: 22-25.
- Ololube NP (2007) The relationship between funding, ICT, selection processes, administration Planning and the standard of science teacher education in Nigeria. *Asia-Pacific Forum on Science Learning and Teaching* V: 8.
- Fari SA (2010) Application of ICTs in Information Sharing Among Academics in Nigeria. *UMYU Journal of Educational Research* 2: 185-190.
- Akinoso SO, Agoro AA, Alabi OM (2017) Innovative and Entrepreneurship: A panacea to Industrial Revolution through Science, Technology Engineering and Mathematics Education. *Journal of Science, Technology, Mathematics and Education (JOSTMED)* 13: 153-161.
- Federal Republic of Nigeria (2004) National policy on education. 4th ed. Lagos: Nigerian Educational Research and Development Council.
- Albirini AA (2006) Teachers' attitude towards information communication technology *Journal of computers and education* 47: 373-398.
- Kyriakidou M, Chrisostomou C, Bank F (2000) Primary teachers' attitude to the use of ICT: A comparative study between Cyprus and the UK. Paper presented at the European Conference on Educational Research. Lahti, Finland
- Bappah MA (2010) Availability and use of Information and Communication Technology (ICT) in six Nigerian University Library Schools. *University Library Schools*.
- Pickover CA (2009) The Loom of God. *Tapestries of Mathematics and Mysticism*.
- Sigh J (2013) Is mathematics the king of all the subjects? Quora.
- Akinoso SO (2017) Information Communication Technology and Collaborative Skills on Students with Learning Difficulties in Mathematics. *LAP Lambert Academic Publishing* pp: 1-65.
- Odogwu HN (2014) A Comprehensive Guide for Teaching Mathematics in Secondary School.
- Akinoso SO (2015) Teaching Mathematics in a Volatile, Uncertain, Complex and Ambiguous (VUCA) World: The use of Concrete - representational- abstract Instructional Strategy. *Journal of the International Society for Teacher Education* 19: 97-107.
- Adebule SO (2004) Gender differences on a locally standardized anxiety rating scale in mathematics for Nigerian secondary schools in Nigerian. *Journal of Counselling and Applied Psychology* 1: 22-29.
- Mbugua ZK (2012) Factors Contributing to students' poor performance in mathematics at Kenya certificate of secondary education in Kenya: A case of Baringo County, Kenya 2: 87-91.
- Schaumburg H (2001) Fostering girls' computer literacy level out the gender difference? Paper presented at the NECC conference, June 25-27, Chicago, IL.
- Derbyshire H (2008) Gender issues in the use of computers in education in Africa.
- Idowu B, Ogunmodede E, Idowu B (2003) Information and communication technology in Nigeria. *IJ Modern Education & Computer Science* 4: 57-66.
- Tomte C, Hatlevik OF (2011) Computer based assessment: Gender differences in self-efficacy ICT related to various ICT-user profiles in Finland and Norway. How do self-efficacy, gender and ICT-user profiles relate to findings from PISA 2006. *Computers & Education* 57: 1416-1424.
- Schumacher P, Morahan-Martin J (2001) Gender, internet and computer attitudes and experiences. *Computers in Human Behavior* 17: 95-110.
- Colley A, Comber C (2003) School Subject Preferences: Age and Gender Differences Revisited. *Educational Studies* 29: 59-67.
- Anyamene A, Nwokolo C, Anyachebelu F, Anemelu VC (2012) Effect of Computer-Assisted Packages on the Performance of Senior Secondary Students in Mathematics in Awka, Anambra State, Nigeria. *American International Journal of Contemporary Research* 2(7).
- Jackson RM (2007) Inequalities. *American Sociological Association. Contexts* 6: 59-61.
- Semerci A (1999) Öğretim Amaçlı Bir Çoklu Ortam Yazılımı Gelistirilmesi, Uygulanmasıve Degerlendirilmesi (Yayınlanmamış Yüksek Lisans Tezi). Ankara Üniversitesi, Ankara.
- Cunningham GB (2006) The relationships among commitment to change, coping with change and turnover intention. *European Journal of work and organizational psychology* 15: 29-45.
- Akkoyunlu B, Yılmaz M (2005) Türetimci Çoklu Öğrenme Kuramı. *Hacettepe Üniversitesi Eğitim Fakültesi Dergisi* 28:9-18.
- McLeod S (2017) Behaviorist Approach. *Simply Psychology*.
- Watson (1913) launches the behavioral school of psychology, publishing an article, *Psychology as the behaviorist views it*.
- Karadeniz A, Akpınar E (2015). Web Tabanlı Öğretimİlköğretim Öğrencilerinin Akademik Başarılarına Etkisi. *Eğitimve Bilim* 40: 217-231
- Sahin TY (2000) İlköğretim Sosyal Bilgiler Dersinde Çoklu Ortamların (Multimedya) Etkiliği. *Eğitim Araştırmaları Dergisi* 1: 68-73
- Akbaba B (2009) Atatürk İlkeleriveİnkılâp Tarihi Öğretiminde Çoklu Ortam Kullanımının Akademik Başarıve Tutumlara Etkisi (Yayımlanmamış Doktora Tezi). Gazi Üniversitesi Eğitim Bilimleri Enstitüsü, Ankara.
- Çoruk H, Çakır R (2015) February 4-6). Çoklu Ortam Kullanımınınİlkokul Öğrencilerinin Akademik Başarılarına ve Kaygılarına Etkisi. Paper presented at Akademik Bilişim Konferansında: Anadolu University. Eskişehir.
- Arıcı N, Yekta M (2005) Meslekive Teknik Eğitimde Çoklu Ortam Araçları Kullanılmış Web Tabanlı Öğretimin Öğrenci Başarısına Etkisi.Ticaretve Turizm Eğitim Fakültesi Dergisi 1: 144-153.

35. Akın E, Çeçen MA (2015) Çoklu Ortama Dayalı Türkçe Öğretimine ve Çoklu Ortam Araçlarına Yönelik Öğrenci Görüşleri. Turk Stud 10: 51-72.
36. Yünkül E, Er KO (2014) The Effect of Multimedia Software Course on Student Attitudes. Eğitimde Kuram ve Uygulama 10: 316-330.
37. Altınışık S, Orhan F (2002) Sosyal Bilgiler Dersinde Çoklu Ortamın Öğrencilerin Akademik Başarıları ve Ders Karşı Tutumları Üzerindeki Etkisi. Hacettepe Üniversitesi Eğitim Fakültesi Dergisi 23: 41-49.
38. Aytan T, Başal A (2015) Türkçe Öğretmen Adaylarının Web 2.0 Araçlarına Yönelik Algılarının İncelenmesi. Turk Stud 10: 149-166.
39. Abdul-Raheem BO (2012) Gender differences and students academic achievement and retention in social studies among Junior Secondary School students in Ekiti State. European Journal of Educational Studies V: 4.