THE EFFECTS OF MATHEMATICS ON STUDENTS ACHIEVEMENT IN COMPUTER SCIENCE EDUCATION IN IKA NORTH-EAST LOCAL GOVERNMENT AREA OF DELTA STATE

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Abstract

The study investigated the effects of mathematics on students' achievement in computer science education. The purpose of this study was to review the changes that computer education has benefited from using mathematics to learn the subject. The population of the study was made up of the entire senior secondary class one students in Ika North East local government area of Delta. The subject was drawn from co-educational school who are offering computer science and mathematics. Twenty (20) teachers, forty (40) males and forty (40) females were selected as sample for the study. The pre-test and post-test were face and content validated. The reliability coefficient of the instrument was 0.86.The study revealed that Students taught using computer technology such as computer Assisted Instruction (CAI) with background knowledge in mathematics performed better than those who were taught with lecture method and with little or no mathematics background in mathematics.

Introduction

The feasible application of computer in the Nigerian classroom for teaching and learning is gradually gaining recognition as a result of the importance and educational appropriateness it offers. In the developing countries, Award (1988) noted that the use of mathematics in teaching computers science are becoming increasingly popular, especially as computer education form integral part of everyday activities in which difference kind of information facilitated the fast delivery of computer science education. Computer can be used to assist instruction, manage instruction and aid design. However, when computer is used to assist instruction, it is referred to as 'Computer Assisted Instruction'. Computer Assisted Instruction according to Abimbola, (1988), is the term used to describe the use of computers to provide instruction directly to students in order to simulate teaching and learning situation.

Taylor (2005) observed that students exposed to computer assisted instruction in the learning of Mathematics Perform better then students exposed to traditional mode of instruction of the same task. As a theoretical discipline, mathematics explores the relationships among abstractions without concern for whether those abstractions have any effect with their counterparts in the real world. Since Mathematics is one of the compulsory subjects in Nigerian secondary schools, students need it to operate varieties of innovative media to aid perfect understanding of the abstract concepts in the subject.

Mathematics is the bedrock of all scientific technological investigations and has provided the route to modern world of science and technology. In order to understand the subject matter, teachers and researcher have developed problem solving models and strategies to consequently, improve the performance of learners in computer science (Adaramola & Onwoiduokit, 2010).The inclusion of Mathematics as a core subject in the Secondary School curriculum is due to the key roles Mathematics has to play in the achievement of the objectives of the secondary school education, such as promoting of science and technology, provision of trained manpower in the applied sciences, technology and commerce, and the acquisition of appropriate skills, abilities and competence both mental and physical, as equipment for the individual to live on and contribute to the development of his society (Federal Republic of Nigeria, 2014).

Students' practical use of computer is possible where the knowledge of subject matter has been achieved. Such deep understanding and application of mathematics concept require their active participation in learning, use of manipulative (concrete materials), practical work and even technological aids to create varieties of learning experiences and meaningful learning in computer science. According to Woodard (2004), Furner and Berman (2003) and Plaisance (2009), the use of manipulative in algebra would enhance young learners understanding of the computer programme that has been used to design the computer software use for learning.

Mathematics is one of the school subjects that any nation needs for industrial and technological advancement, useful for most vocation and higher specialized courses of learning such as computer science (Odili, 2006; Sidhu, 2006). According to Nwoke and Nnaji (2011), Mathematics is the study of quantity, structures, space and change. It developed through the use of abstraction and logical reasoning, from counting, calculation, measurement and the study of the shapes and motion of physical objects present in computer programmes. Mathematics is an excellent vehicle for the development and improvement of a person's intellectual competence in logical reasoning, spatial visualization, analysis and abstract thought in the learning of computer science. (FGN, 2007). Students who study Mathematics, therefore, develop numeracy skill, reasoning, thinking skills and problem solving skills through the learning and application of Mathematics in the uses of computers.

Teachers' attitudes towards computers vary mostly as a function of teachers' age or years in service. Complete 'ignorance' attitude towards computers still continues, although its magnitude is weaker compared to past years. This attitude is mostly shared by teachers who had had their training towards its computer pedagogical uses and who insist on using the traditional modes of teaching. A second major attitude is not being able to abandon their traditional habits completely foreseeing its potential for the future of education. Most prevalent and widening attitude is the realization and acceptance of the importance of computers for education especially the Computer assisted instruction (CAI).

Effects of Mathematics on Computer Education

The learning behaviors comprise of a network of stimuli response associations in the fundamental idea underlying the application of computer programs using mathematics. This idea has been the natural continuation of the behaviorist mode of teaching. The teaching and learning of computer science have been centered on making the learning to improve their achievement in computer education using a good teaching strategy. Hartley (1981) noted that the stimuli response bonds are established by providing positive reinforce-ments such as knowledge of results provided by mathematics during teaching and learning. Then, it was the teacher (or the organizer of the instruction) who was responsible for the selection and arrangement of content to help the desirable responses to be elicited in computer science using his mathematic knowledge. Where inadequate teaching leading to poor achievement take place, a remedial teaching as well as post teaching discussion may take place to clarify those things that could not allow the learner to understand the concept or topic that has been taught. Then, this process leads to the discovery of feedback, the message which follows the response made by the learner during the computer science lesson. It is also the information which shows the error and informs the student to correct this error. The feedback-corrective cycle, learning takes place by rewarding the correct associations by questions and answers (Howe and du Boulay, 1981) which is known as the reinforcement learning in computer science as subject.

Statement of the problem

There are different innovations that are being applied in the delivery of curriculum content to students especially in computer education. Research evidence shows that the use of mathematics could bring about improvement in students' achievement, speeds, up learning rate and enhances better retention, and

encourages the development of better attitude in computer science teaching and learning. But the chief examiners report on students' performance in computer science at the West African Senior Certificate Examination showed that the student performance in computer science has not been encouraging.

However, there is need to really find out, whether the use of mathematics on CAI will produce any difference in the performance of students in computer science. In the same connection, can mathematics assets in the understanding of computer science? Research reports showed that academic achievement of student is the ability of the student to study and remember facts and being able to communicate his knowledge orally or in written form even in an examination condition. Secondary education plays a crucial role in laying the foundation for the further education of students. If a good foundation is laid at the secondary school level, students can better cope with the challenges of life and profession with great ease. Factors that influence students' academic achievement at the senior secondary school might not only include teacher factor arising from poor teaching methods but also students' attitude towards school, interest in learning, study habit, attribution, self-efficacy, intelligence, and motivation. Thus, students' academic achievement cannot be completely accounted for by only one or two variables but a number of them. This implies that students' academic performance could be enhanced through identifying and manipulating computer science using mathematics knowledge. Based on this, the study tried to investigate the effect of mathematics education on student's achievement in computer sciences at the senior secondary schools in Delta state, Nigeria. The focus will be on Ika North East

Purpose of the study

The study examined the effects of mathematics on students' achievement in computer science education, and it further examined the role of mathematics in the teaching and learning of computer science in the secondary school system.

Research questions

The study sought to answer two research questions as stated below:

1. Is there any effect of mathematics on students' achievement in computer science?
2. What is the gender performance difference in the teaching and learning of computer science with students of good mathematical background?

Research Hypotheses

The following hypotheses are tested at 0.05 level of significance

1. There is no significant difference between the mean achievement scores of computer science students who were taught using mathematics as background knowledge and those without knowledge of mathematics.
2. There is no significant difference between the mean achievement scores of male and female computer science students with mathematics background and those without mathematics background.

Methodology

The population for this study was made up of the entire senior secondary class one (SSI) student in Ika North East Local Government Areas, Delta State. The sample subjects were drawn from co-educational schools who are offering computer science and mathematics. The samples from co-educational schools were selected by the use of stratified random sampling technique purposively. This method was chosen so that the gender variable could be appropriately represented. Twenty (20) mathematics students were randomly selected for the study from each of the schools. In all there were forty (40) males and forty (40) females. The students with good background in mathematics were taught the same concept of quadratic equation using computer assisted instructional package CAI). The main instrument used in generating data for this study was the computer science and Mathematics Achievement test (CSMAT) which is made up of twenty-five (25) multiple choice objective items designed to measure specific learning outcomes related to the concepts of the study. The instrument was validated for the face and content validity and

reliability test of 0.86 was obtained before using the research instrument in the main study. A question is followed by five (5) options lettered (A-E) out of which only one (1) was correct. Students were instructed to select only one option as answer for each item. The data for testing the hypotheses were collected using the pretest and posttest administered to the subjects used for the study. Each of the test was marked and scored over hundred percent (100%). The experimental groups were exposed to computer science lesson such as Computer Assisted Instruction (CAI)with students that has good mathematical background in quadratic equation for a period of four weeks while the control group were taught the computer science lesson with no mathematics background knowledge of quadratic equation using conventional (talk and chalk) method. After the duration of four weeks of treatment for the experimental group and four weeks of conventional method with control group, posttest was administered to both groups at the same duration in the usual Paper and pencil method.

The data collected were analyzed using mean, standard deviation and the t-test statistical analysis. The level of the significance adopted for the analysis was $P \leq 0.05$.

Analysis and Discussion of Results

Hypothesis 1: There is no significant difference between the mean achievement scores of computer science students taught with knowledge of quadratic equation and those taught without the knowledge of quadratic equation.

To test this hypothesis, the posttests mean scores of the experimental and control groups were computed and compared using the t- test statistic. The result is shown in table 1.

Table 1*:* T-test comparison of the posttest mean scores of the experimental and control groups

Variable	n	df	$\bar{x}$	SD	t-Cal. value	t-critical value	Remark
Experimental group	40	39	67.84	5.87	14.95	2.02	Significant
Control group	40		560.85	5.39			

The result of the t-test analyses in table 1 showed that there was significant difference between the posttest mean scores of the experimental and control groups at 0.05 level of significant ($t = 14.95$, $df = 39$, $p \leq 0.05$). Hypothesis 1 was therefore, rejected. This implied that there was a significant difference between the performances of students taught with computer science with mathematics background knowledge and those taught without mathematics back-ground at (0.05 level of significance). Students taught using computer technology such as computer Assisted Instruction (CAI) with background knowledge in mathematics performed better than those who were taught with conventional method and with little or no mathematics background in mathematics. This result is in line with the research report of Heinz (2005). According to Heinz (2005) students with good background in mathematics achieve much better in the learning of computer science than students with little or no background in mathematics. With good mathematical knowledge, student can easily learn and have the ability to construct algebraic and statistical graphs using computers. Students with good background in mathematics learning programming and spreadsheets much easier than those students without knowledge of mathematics and tends to learn and apply computer science during their lesson in which they were taught with computer Assisted Instruction (CAI) (Yildiz and Gokcek, 2018). In the data collected, the students showed evidence of the importance of mathematics as they explain the programme, the logic and algorithm that were written in mathematics language. Liao (2007) also noted that the inability of the students to understand the concepts was as a result of lack of knowledge of the required skills and concepts to understand computer science.

Hypothesis 2: There is no significant difference between the mean achievement scores of male and female computer science students with mathematics background and those without mathematics background.

To test this hypothesis, the posttest means scores of the experimental and control groups were computed and compared using the t- test statistic. The result is shown in table 2.

Table 2*:* T-test comparison of the posttest means scores of the experimental and control in terms of Sex.

Variable	n	df	$\bar{x}$	SD	t-Cal. value	t-critical value	Remark
Experimental group	40	38	5.99	6.48	14.95	2.02	Significant
Control group	40		5.38	5.83			

From the result in table 2, it was shown that there was no significant difference between the posttest mean scores of male and female mathematics students in the experimental group at 0.05 level of significance ($t = 14.95$, $df = 38$, $p \geq 0.05$). Null hypothesis 2 was therefore accepted. The performances of male and female taught mathematics in the experimental group were equally enhanced by the use of the computer Assisted Instructional Package for teaching students of computer science with good mathematics background. This finding is in line with the research report of Plaisance (2009), Ogunkunle (2015) and Yildiz (2018) who all noted that students with good mathematics background perform better in computer science than students with poor or no background in mathematics. In terms of gender, there were no difference in achievement but their achievement in computer science were generally enhance as a result of knowledge of mathematics.

Conclusion and Recommendation

The result of the test shows that students who were taught quadratic equation before using the computer assisted instruction to teach them computer science perform better than students with no mathematical knowledge of the topic and were taught computer science using the traditional method of teaching. The result shows that mathematical knowledge aided the understanding of the computer science. The students understand the topic of using CAI to construct quadratic graph using computers than those who have no knowledge of the topic.

Mathematics concepts are ideas or mental impressions which are primarily related to computing, quantitative relationship, syste-matic reasoning or configuration. Students learn these concepts differently with differential performance rating. Some of the students get low grades in their performance due to lack of knowledge of concept, understanding of the fundamental manipulation or mathematical skills which has created a lot of difficulties for learners in the study of computer science (Larbi and Mavis, 2016).

Application of mathematics to all aspects of human endeavor coupled with the need to create student-centered on computer learning which takes place in the classroom, engage learners in their learning tasks, improve learners' interest and consequently achievement in the school subjects has necessitated the use of computer assisted instruction (CAI) in teaching computer science. This study has found out that mathematics improved students' achieve-ment and interest in computer science than the lecture teaching methods. These results therefore revealed that CAI is a viable alternative to the conventional lecture teaching methods in teaching computer science. Moreover, the use of computer provides powerful tools to support the shift to student-centered learning and is capable of creating a more interactive and engaging learning environment for teachers and learners.

Based on the study, the following recommendations were made.

1. Curriculum planners should encourage learners to develop a strong background in mathematics before learning computer science and the use of computer in teaching/ learning in our educational systems should also be encouraged.
2. Computer education should be made compulsory for teachers and students at all levels of our educational systems and in the case of mathematics.
3. In-service training should be given to teachers on the production and the use of computerized instructional media so that they can appropriately use the modern instructional technology.
4. School should be equipped with mathematics, computers and internet facilities and other necessary instructional packages for teaching and learning.

References

Abimbola, I.O. (1988). *The role of computer in education: In National Journal of Technical Education 5 (1 & 2), 26 – 33.*

Adaramola, M.S. & Onwioduokit, F.A. (2010). Relative effectiveness of two problem-solving models on students' performance in further mathematics in senior secondary schools in Rivers State. *Nigeria Journal of Science and Science Education* 8(2) 24-45.

Award, E.M. (1988). *Management Information systems: Concepts Structure and Application. Califonia:* The Benjamin Cummings Publishing Company Inc.

Curriculum Planning and Developmentt Divission (2007). *Science syllabus for Primary*, 2008. Ministry of Education, Singapore.

Ekiregwo, P.O. (2001). Using computer assisted instruction in science class creation of CDs and Diskettes with CAIs. *A workshop paper presented at the "train-the-trainers" workshop by UNESCO/NCCE.*

Fakomogbon, M.A. (2002). Instructional Media technology and services for special learners. *Nigerian Journal of Educational Media and Technology. Vol 10:1*

Furner, J.M. and Berman B.T. (2003)- Review of research: math anxiety: overcoming a major obstacle to the improvement of student math perfor-mance *Journal of Childhood Education T*aylor & Francis Group. 79 (3) pp170-174.

Hartley, R.(1981). An appraisal of the computer assisted learning in the United Kingdom. In N. Rushby (Ed), Selected Readings in Computer Based Learning, 30-43.

Heinz, S. (2005). The construction of New Mathematical Knowledge in Classroom interaction. *An Epistemological Perspe-ctive.* Springer, U. S. A.

Howe, J.A.M. and du Boulay B. (1981) Microprocessor assisted learning: turning the clock back. In N. Rushby (Ed), Selected Readings in Computer Based Learning, 119-126.

Larbi, E. and Mavis, O. (2016). The Use of Manipulatives in Mathematics Education. *Journal of Education and Practice. Vol. 7, No. 36.*

Liao,Y.C (2007). Effects of computer assisted instruction on students' achievement in Taiwan; a metal analysis. *Computer and Education 48 (2) 216-233.*

Nwoke, B.I. & Nnaji, L. N. (2011). Effects of using mathematics laboratory in teaching mathematics on students' achievement in Mathematics. Journal of Issues on Mathematics, Vol. 14.

Odili G., A. (2006). Mathematics in Nigerian secondary schools. A teaching perspe-ctive Port Harcourt: Anachuna Educational books.

Ogunkunle, R.A. & George, N.R. (2015). Integrating ethno-mathematics into secondary school mathematics Curri-culum for effective artisan creative skill development. *European Scientific Journal 11(3) 386 – 397.*

Ogunkunle, R.A. (2007). Constructivism: An instructional strategy for sustaining students' self-concept in secondary school Mathematics. *Journal of the Science Teachers Association of Nigeria*, 41, 30-50.

Plaisance, D. V. (2009). A teachers' quick guide to understanding mathematics anxiety. Louisiana Association of tea-chers of mathematics journal, 6(1), 4-8.

Sani, R. O. and Osungbemiro, N. R. (2002). 'An innovative I.T. – Based approach to the teaching of biological sciences at the secondary schools level of education'. *Paper presented at the 2nd annual conference of Ondo State* STAN.

Sidhu, K.S. (2006). *The teaching of mathe-matics*. New Delhi: Sterling Publishers Private Limited.

Wasagu, M.A. and Mohammad R. (2007). Female education in Science, Tech-nology and Mathematics and sustainable development in the millennium.50th Annual Conference proceeding of Science Teachers Asso-ciation (STAN). 86-88.

Woodard, T. (2004). The effects of math anxiety on post-secondary develop-mental students as related to achieve-ment, gender and age. Inquiry, 9(1).

Taylor, R.L and Olek C.Z. (2005). The Finite Element Method for Solid and Structural Mechanics.

Yildiz, H. Gokcek, T. (2018) The Develop-ment Process of a Mathematic Teacher's Technological Pedagogical Content Knowledge. European Journal of Educational Research, vol. 7(1): 9-29