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EFFECT OF MULTIMEDIA INSTRUCTION (MI) ON STUDENTS' PERFORMANCE IN DATA STRUCTURES AND ALGORITHMS IN PUBLIC POLYTECHNICS IN NASARAWA STATE

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ABSTRACT: *The study investigated the effect of multimedia instruction on students' academic performance in Data Structures and Algorithms (DSA) in two public Polytechnics in Nasarawa State. The population of the study comprised one hundred and twenty (120) National Diploma one (NDI) students of Computer Science from Nasarawa State Polytechnic, Lafia (now Isa Mustapha Agwai I Polytechnic, Lafia) and Federal Polytechnic, Nasarawa. The study adopted a quasi-experimental research approach using the non-randomized control group pretest-posttest design. Intact classes were maintained and an experiment of two equivalent groups was designed—one was the experimental group while the other was the control group. The group was determined using a simple random sampling technique. Sixty eight (68) students in Nasarawa State Polytechnic, Lafia constituted the experimental group while fifty two (52) students in Federal Polytechnic Nasarawa constituted the control group. The experimental group was exposed to multimedia instruction (MI) on DSA while the control group was exposed to conventional instruction. The instrument for data collection was a DSA performance test titled 'Data Structure PerfTest (DPT)'. The DPT contained 20 objective items from the topics treated. The reliability of the instrument was determined using the test-retest approach and a correlation coefficient of .87 was attained. Inferential statistics such as t-test was used to test the null hypothesis at 0.05 alpha level of significance. Data analysis was done using the statistical package for social science (SPSS). The finding showed that the treatment group (MI) performed significantly better than its counterpart in the control group which was exposed to conventional instruction. The study recommended expansive use of multimedia instruction in teaching and learning of Data Structures and Algorithms in tertiary institutions.*

KEYWORDS: Data, Algorithms, Multimedia instruction, Performance.

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INTRODUCTION

In recent times, the challenges of education cut across social, economic and cultural backgrounds, the most vital of which are overpopulation, education philosophy development and the change of teacher's role, the spread of illiteracy, lack of qualified teachers and technological advancement (Aloraini, 2005). Teachers are now highly involved in utilizing modern teaching techniques leveraging technologies to tackle some of the major challenges which education and its productivity encounter (Wilkinson & Abd El-Halim, 2006). To improve educational productivity, educators must mainstream technology into education; hence, mainstreaming the technological media within multimedia into education is the blueprint for inestimable applications of computer technologies in education and beyond (Al-A'ny, 2000).

The concept of multimedia came into existence with the emergence of sound cards, compact disks, digital camera and video technologies, all of which made computer a vital instructional tool (Aloraini, 2005). In modern times, multimedia has been expanded to become a field on its own. However, the main constituent of multimedia technology is interaction and most of its applications are characterized by that. Consequently, multimedia programs provide more effective and more influential experiments than using each technology separately (Holsinger, 2005). Multimedia instruction includes texts, pictures, animation, audio and video components aimed at promoting learning; hence, the design of multimedia instruction should be guided by the science of learning (i.e., the scientific study of how people learn), the science of assessment (i.e., the scientific study of how to know what people learn), and the science of instruction (i.e., the scientific study of how to help people learn) (Richard, 2011).

On science of learning, Mayer (2011) stated that, the cognitive theory of multimedia learning is based on three principles from cognitive science, i.e., dual channels, limited capacity and active processing, and that the cognitive processes during learning involves selecting words and pictures, organizing and integrating them. Mayer also emphasized five kinds of representations during learning—external representations, sensory copies in sensory memory, images and sounds in working memory, pictorial and verbal models in working memory, and knowledge in long-term memory. On science of assessment, Mayer (2011) further stated that, this focuses on transfer in the context of three kinds of learning outcomes which he named as no learning, rote learning, and meaningful learning. And on science of instruction, Mayer stated that, it deals with reducing extraneous processing, managing essential processing, and fostering generative processing.

To further understand what multimedia instruction is, Holsinger (2005) noted that, multimedia instruction engages different senses of the learner simultaneously; hence, it has many stimuli such as texts, spoken words, sound and music, graphics, animations and still pictures involved in the process of learning. He pointed out that, to support the participation of the various senses of the learners in diverse syllabi, these elements should be mainstreamed in a comprehensive instructional presentation. Multimedia instruction has so many potentials and as such Zaitoun (2002), Hadmin (2000), Qandeel (2008) and Alfar (2009) noted that, multimedia instruction brings information closer to reality using video clips or other kinds of presentations. They also opined that, adding music makes a concept clearer and in turn attracts learners' attention. They further stated that multimedia instruction increases the attention and interaction between learners and the educational subjects, providing instructions from simple to complex, and grading is done based on learners'

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abilities. Also, MI provides teachers with a new educational style and encourages curiosity; hence, providing learners with broader perspectives of a topic guides them to peer learning and provides simultaneous feedback to them. They further added that, MI helps learners remember and transfer knowledge, supports the users work and innovation which makes the possession of a computer a necessity for both the student and the teacher. These MI potentials necessitated this study which sets to determine the effect of MI on students' academic performance in data structures and algorithms.

Statement of the Problem

Most times, computer science students do devalue the importance of learning data structures and algorithms, considering it as complicated, abstract and irrelevant; however, the reality is that, big companies like Amazon, Google and Microsoft often ask questions related to algorithms and data structures to check the problem solving abilities of candidates during job interviews. Secondly, data structure is used in many program designs and as such, the study of data structures and algorithms rightly form the central course of any curriculum in computer science and engineering. Today, most curriculums in computer science cover topics such as introduction to computing, principles of programming language, programming methodologies, algorithms, e.t.c. However, it is very impossible to understand these topics without first acquiring thorough knowledge of data structures and algorithms. Moreover, today's computer has become unimaginably fast and to use the full strength of computing power to solve different sorts of complicated problems through elegant program design, a good knowledge of data structures is highly required.

Despite the importance of data structures and algorithms, computer science students have continued to perform poorly over the years judging from the National Diploma result of 2015 to 2018 academic sessions in Nasarawa State Polytechnic, Lafia and Federal Polytechnic, Nasarawa. The result summary for those sessions in the two polytechnics showed that 33% of the students scored between 45 and 58 marks, 10% of the students scored between 59 and 64 marks, and 57% of the students scored between 25 and 38 marks. From this, it is evident that the general failure rate is alarming; thus, an urgent solution is a necessity. Also, from personal observations and interaction with some students, they perceive the course as difficult and so abstract and pointed out that the more they try to understand the course, the more confused they get. This inspired the need for this study to determine whether a shift from face to face instructional strategy to multimedia instruction will have effect on students' academic performance.

Purpose of the Study

The study sets to achieve the following objectives:

i. To determine the pretest mean scores of control and experimental groups on data structures and algorithms.

ii. To determine the posttest mean scores of experimental and control groups on data structures and algorithms.

iii. To compare the pretest and posttest mean scores of the experimental group on data structures and algorithms.

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Hypotheses

The following null hypotheses were formulated and tested at 0.05 alpha level:

Ho_1: There is no significant difference between the pretest mean scores of the control and experimental groups.

Ho_2: There is no significant difference between the posttest mean scores of the control and experimental groups.

Ho_3: There is no significant difference between the pretest and posttest mean scores of the experimental group.

METHODOLOGY

The study was a quasi-experimental research of pretest-posttest equivalent control group design. Two public polytechnics—Nasarawa State Polytechnic, Lafia (now Isa Mustapha Agwai I Polytechnic, Lafia) and Federal Polytechnic Nasarawa, Nasarawa State—were selected for the study and a total of one hundred and twenty (120) NDI students of computer science made the study population. Two equivalent groups—experimental and control groups—were formed. A simple random sampling technique was used to determine the group. Intact classes were maintained with the control group having 52 students while the experimental group had 68 students. The instrument for data collection was Data Structure PerfTest (DPT). The DPT instrument contained 20 items. The instrument was sent to experts in computer science and programming, and mathematics, test measurement and evaluation. They judged it scientifically and pedagogically in terms of its suitability and clarity. After knowing their views and suggestions, few questions were modified; then the test came out in its final version. The test retest approach was used to ascertain the reliability of the instrument and the two sets of scores were correlated using the Pearson correlation coefficient. A reliability of .87 was attained. The DPT instrument was used for both pretest and posttest. The topics covered were Stack, Queue, Binary Tree and Sorting. The experiment lasted for six (6) weeks and t-test was used to test the null hypotheses at 0.05 alpha level.

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RESULTS

The results are presented in tables below:

Table 1: Pretest of the experimental and control groups

Group Statistics

	Group	N	Mean	Std. Deviation	Df	p.value	L of sig
pretest	Experimental	68	42.84	10.581	118	1.43	NS
	Control	52	40.33	7.878			

Table 1 shows that the experimental and control group did not differ significantly looking at their mean scores. The experimental group had 42.88 while the control group had 40.33. Also, judging from the P value, the P value of 1.43 is higher than the alpha value (0.05) which implies that the first null hypothesis, which states that there is no significant difference between the pretest mean scores of the control and experimental groups, is upheld. It shows that, the students have comparable academic standing.

Table 2: Posttest of the groups

Group Statistics

	Groups	N	Mean	Std. Deviation	Df	P.value	sig
posttest	Experimental	68	61.66	13.974	118	.005	S
	Control	52	42.38	8.603			

Table 2 indicates that the experimental group attained a mean score of 61.66 while the control group had 42.38. Also, the P value is .005 which is less than the alpha value (0.05). Therefore, the second null hypothesis, which states that there is no significant difference between the posttest mean scores of the experimental and control group, is rejected. The experimental group performed better than the control group in the posttest and this is attributed to the treatment.

Table 3: Pretest and Post of experimental group

	Group	N	Mean	Std. Deviation	Df	p.value	L of sig
pretest	Experimental	68	42.84	10.581	67	.003	S
posttest	Experimental	68	61.66	13.974			

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Table 3 shows that the group had a mean score of 42.84 in pretest and 61.66 in posttest. The P value stood at 0.003 which is less than the alpha value (0.05). Therefore, the null hypothesis, which states that there is no significant difference in pretest and posttest mean scores of the experimental group, is rejected. The group demonstrated higher level of understanding and conceptualization of the subject matter when exposed to the treatment.

DISCUSSION OF FINDINGS

The result showed that the treatment group performed significantly better than the control group exposed to traditional face-to-face instruction. This is in agreement with Olga (2008), who found that the experimental group exposed to CAI performed better in mathematics than the control group exposed to conventional instruction. The finding also conforms to Jesse, Twoli and Maundu (2014) who found that students taught chemistry with programmed instruction performed significantly better than those taught with the traditional teaching method. The finding also concurs with Kareem (2015) who investigated the effects of multimedia instruction (MI) on students' performance in biology and found that, MI significantly improved students' academic performance in biology compared to the traditional teaching approach. Furthermore, the finding is in-line with Olakanmi, Gambari, Gdodi and Abalaka (2016), who found that students who were taught chemistry with multimedia instruction attained higher performance than those who were taught with the traditional instruction. This then implies that teaching strategy constitutes a factor in students' academic performance.

Recommendation

The study recommends expansive use of multimedia instruction in teaching and learning of data structures and algorithms in all tertiary institutions in Nigeria.

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