Effect of Computer-Assisted Instruction on Pupils' Performance in Quantitative and Verbal Reasoning

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ABSTRACT

There seem to be a low attention towards the use of computer as a medium of instruction to optimize education especially in primary schools. This paper, through a quasi-experiment examined the effects of Computer-Assisted Instruction (CAI) on pupils' performance in Quantitative and Verbal Reasoning. The population for the study comprised all the public primary school pupils in Lagos State. The target population consists of all the primary five pupils in Lagos State public primary schools. The study purposively sampled 2 Government owned schools based on the availability of computer facility in themand randomly sampled 154 primary school pupils. The research instrument that was used for the study was a researcher-made model. The data generated were analyzed using percentages while the hypotheses formulated in this study were tested using Analysis of Covariance (ANCOVA) at 0.05 alpha level ofsignificance. The findings show that CAI has a significant positive effect on pupils' performance in Quantitative and Verbal Reasoning. Based on the tested hypotheses, it is hereby recommended that government should provide CAI devices to all public primary schools in Lagos State and proffer the meansof using the CAI devices (electricity).

Keywords: computer-assisted instruction, Pupils' Performance, Quantitative Reasoning, Verbal Reasoning

INTRODUCTION

Education is globally recognized as an integral social service that impacts skills and competence that are pertinent to human development. Education is seen as an instrument par excellence to enhance the quality of life that brings wide-ranging benefits to individuals and societies (NPE, 2003).

Considering the objectives of primary education in Nigeria, the unprecedented interaction between primary school pupils and technological devices cannot be far-fetched. Several advances in the field of science and technology and other relevant fields have opened up a plethora of technological devices and products. In recent times, Computer-Assisted Instruction (CAI) has become one of the most integral parts of education in the contemporary world. The use of CAI in teaching has become a functional way of providing education to learners (Gambari et al., 2013).

Computer-Assisted Instruction in the field of education has replaced the chalkboard, textbooks, radio/television, rote learning, and teacher-centeredness in teaching (Laleye, 2019); to a higher interactive potential for pupils to develop their individual, intellectual, reasoning skills and creative ability (Kosoko-Oyedeko & Tella, 2010). According to Alade (2011), when appropriate content matches appropriate strategies, students and teachers will benefit immensely. CAI as a means of instruction in education provides an interesting environment for learning and promotes creativity in learners. Okebukola (2013) postulatedthat CAI can be applied to all ages and forms of education, from pre-school to professional school and even in many employment areas. It can also be used in a wide range of fields including all the main disciplines in elementary and secondary school.

The effect of CAI on the verbal and quantitative reasoning of primary school pupils is paramount. It is

worthy to note that quantitative and verbal reasoning goes beyond school subjects. Quantitative and verbal reasoning provide valuable information about cognitive abilities that are important to academic success. The National Council of Teachers of Mathematics (NCTM, 2000) explained that quantitative reasoning is broader in scope than can be captured in an assessment setting. Quantitative reasoning is synonymous with numerical reasoning, numeracy, or quantitative literacy. Quantitative reasoning encompasses mathematical concepts but it is not mathematics. According to Steen (2004), Quantitative reasoning only utilizes basic mathematics skills to carry out complex reasoning and decision-making process. Ko and Knuth (2013) established some reasoning skills needed for quantitative reasoning. These include; informal deductivereasoning, example-based reasoning, and further education in mathematics. The Association of America Colleges and Universities (2007) proposed that quantitative reasoning requires rigorous and creative thinking, and the application of basic mathematical skills to interpret data, draw conclusions, and solve problems within a disciplinary or interdisciplinary context.

Furthermore, Quantitative reasoning deals with cognitive skills which are necessary for mathematical success, such as working memory, inhibitory control, and shifting skills. Of recent, quantitative reasoning skills have been suggested as an important aspect of good mathematical reasoning abilities (Cragg& Gilmore 2014). Attridge & Inglis (2013) noted that individuals with strong quantitative reasoning skills possessed the ability to reason and solve quantitative problems from a wide array of authentic contexts and everyday life situations; such individuals understand and create sophisticated arguments supported by quantitative evidence and they can clearly communicate those arguments in a variety of formats using appropriate words, tables, graphs, mathematical equations.

Conversely, Verbal reasoning deals with the ability to understand interpret, and logically reason using concepts framed in words. Verbal reasoning involves using information given to make meaning and applying the information to new learning (Burton & Ramist, 2001). James and David (2011) asserted that verbal reasoning is a major facet of general cognitive ability. The Cambridge shire community services ascertain that verbal reasoning skill develops between the ages of four and six years. At this stage, children begin to ask questions, make predictions, and classify things. The Institute for the Promotion of Teaching Science and Technology (2011) in their view suggested that teachers should teach students to solve problems by setting up the problem for them depending on their ability; easy problems for students whohave low problem-solving skills and increase the difficulty level for students who have the higher ability. This would bring about the evolution of students' intelligence and abilities into sensible actions (Ben-Chaim et al. 2000).Also, Angelo (1995)asserted that verbal reasoning does not develop as a result of maturation;but involves skills that are notoriously difficult to teach and learn. Barak, Ben-Chaim, & Zoller (2007) recommended that teaching should include not only the creation of students' knowledge capabilities but also the abilities to think, make decisions, and problems solving.

The main thrust of the paper, therefore, is to assess the effect of CAI on pupils' performance in quantitative and verbal reasoning.

Research Questions

1. What is the effect of CAI on pupils' performance in quantitative reasoning?
2. What is the effect of CAI on pupils' performance in verbal reasoning?

Research Hypotheses

The following hypotheses are generated to be tested in the study:

H_{01}: CAI usage has no significant effect on pupils' performance in quantitative reasoning

H_{02}: CAI usage has no significant effect on pupil's performance in verbal reasoning

The research design used for this study was a Quasi-experimental design. A quasi-experimental design was used to measure pupils' performance in quantitative and verbal reasoning respondents.

In the study, the two intact groups were classified into the experimental group and the control group. Both groups were exposed to a pre-test on quantitative and verbal reasoning after which the experimental group alone received CAI Performance-based learning treatment. Afterward, a post-test was administered to both groups. The data obtained from the pre-test and post-test of both groups were analyzed by comparing their mean scores in order to determine the effect of the experimental treatment.

The population for the study comprised all the public primary school pupils in Lagos State. The target population was all the primary five pupils in Lagos State public primary schools.

A simple random sampling technique was used to select two schools from the public primary schools in Lagos State. Two schools are considered to be selected because the study is a quasi-experimental research type; choosing many schools may be too cumbersome for the study. The research instrument that was used for this study was a researcher-made test and a Dialogue level form of CAI application.

The instruments were subjected to face and content validity to establish the validity. The reliability of the instruments was ensured by using the test re-test method. The data collected was analyzed using Pearson Product Moment Correlation of Co-efficient to ascertain its reliability index. The reliability index of the test on quantitative reasoning was 0.75, while the reliability index of the verbal reasoning test was found at 0.78.Analysis of Covariance (ANCOVA) was used to test the hypotheses using Statistical Package for Social Sciences (SPSS 21.0) window version at 0.05 level of significance.

Frequency count and percentage were used to describe the personal characteristics of respondents.

Table 1: Frequency Distribution of the Respondents based on Group

Group	Frequency	Percentage (%)
Experimental	88	57.1
Control	66	42.9
Total	154	100.0

Table 1 shows that a total of 154 respondents participated in the research. 57.1% of the respondents were in the experimental group and 42.9% were in the control group. By implication there were more respondents in experimental group than the control group; this is because the number of respondents in the experimental and control classes varied.

Hypotheses were formulated in this study and tested at 0.05level of significance. Analysis of Covariance (ANCOVA) was used to test each of the hypotheses

H_{0i}: *CAI usage has no significant effect on pupils' performance in quantitative reasoning*

In order to test this hypothesis, the scores from the groups (control and experimental) on quantitative reasoning tests were collated and analysed using Analysis of Covariance (ANCOVA).

The result is presented in table 2.

Table 2: Effects of ICT on students' Quantitative Reasoning

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	20296.70[a]	2	10148.35	31.23	0.01
Intercept	22681.88	1	22681.88	69.80	0.01
PRE_TEST	9386.93	1	9386.93	28.89	0.01
GROUP	17966.90	1	17966.90	55.29	0.01
Error	24048.11	74	324.97		
Total	323950.00	77			
Corrected Total	44344.81	76			

R Squared = .46 (Adjusted R Squared = .44)

Results: p(Group)=0.01, α =0.05

Table 2 shows the F-ratio of Group (Control and experimental) of 55.29 at (1, 77) degree of freedom with p-value of 0.01 at 0.05 level of significance. Since the p-value 0.01 was less than the level of significance of 0.05 (0.01<0.05). Hence, the null hypothesis was rejected. This means ICT have significant effect on pupils' performance in Quantitative reasoning. This was further tested using the post-test mean scores of the two groups on Quantitative Reasoning as shown in Table 3.

Table 3: Post-test Mean score of the groups on Quantitative Reasoning

Group	**Mean**	**Std. Deviation**
Experimental	70.5	19.94
Control	46.5	23.01
Total	117.0	42.95

As shown in Table 3 students exposed to CAI Performance-based learning had the higher mean score of 70.5, while students that were not exposed to CAI Performance- based learning had a mean score of 46.5 which indicate the significant difference in the performance of the groups.

H_{02}: *CAI usage has no significant effect on pupils' performance in verbal reasoning*.

In order to test this hypothesis, the scores from the groups (control and experimental) on verbal reasoning tests were collated and analysed using Analysis of Covariance (ANCOVA). The result is presented in table4.

Table 4: Effects of ICT on Students' Verbal Reasoning

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	21449.89[a]	2	10724.95	49.92	.01
Intercept	10989.03	1	10989.03	51.15	.01
PRE_TEST	9448.92	1	9448.92	43.98	.01
GROUP	14836.76	1	14836.76	69.06	.01
Error	15898.81	74	214.85		
Total	313350.00	77			
Corrected Total	37348.70	76			

R Squared = .57 (Adjusted R Squared = .56) Results: p (Group) = 0.01, α = 0.05

Table 4 shows the F-ratio of Group (Control and experimental) of 69.06 at (1, 77) degree of freedom with p-value of 0.01 at 0.05 level of significance. Since the p-value 0.01 is less than the level of significance of 0.05 (0.01<0.05), the null hypothesis was rejected. This means CAI have significant effect on pupils' performance in verbal reasoning. This was further tested using the post-test mean scores of the two groups on verbal Reasoning shown in Table 5

Table 5: Post-test Mean score of the groups on Verbal Reasoning

Group	Mean	Std. Deviation
Experimental	70.7	17.53
Control	45.5	19.00
Total	115.2	36.53

As shown in Table 5, students exposed to CAI Performance-based learning had the higher mean score of 70.7 and students that were not exposed to CAI Performance- based learning had the lower mean score of 45.5. This indicated that students exposed to CAI Performance- based learning performed better than those that were not expose to it.

SUMMARY OF THE FINDINGS

Based on the analysed data and the results, the following are the summary of the findings:

1. CAI usage had significant effect on the quantitative reasoning of primary school pupils in Lagos State, Nigeria (p-value 0.01<0.05level of significance)
2. CAI usage had significant effect on the verbal reasoning of primary school pupils in Lagos State, Nigeria (p-value 0.01<0.05level of significance)

DISCUSSION

This study revealed that there was significant effect of ICT on pupils' performance on both quantitative and verbal reasoning. Invariably, the use of ICT appears to enhance the academic performance of primary school pupils in teaching and learning. This is contrary to the report of the studies of Terry, Lawal et al. (2003); and Brown and Liedholm (2002) whose findings showed that the use of ICT had no effect on pupils' performance. Similarly, the study by Leuven et al.(2004) on the key role for ICT in higher educationshowed no importance of the role for ICT in higher education. However, Li, Le Boeuf, Basu and Turner(2003), Fuchs and Woessman (2004),Okwilagwe (2001) all reported positive impact of ICT on students' achievement. The findings of this study also supported the positive effect of ICT on pupils' performance. During the research, ICT was used to teach pupils in the experimental group. ICT enhanced all categories of learners' performance. Pupils who scored below 40% in the pre-tests were able to perform excellently in their post-tests. Also, ICT had a positive effect on pupils' performance in quantitative and verbal reasoning because ICT performance-based learning made the pupils eager to learn and made learning more interesting to them. Pupils were of the opinion that they learn and understand better when they learn with ICT. Furthermore, according to the pupils, CAI helps them to see what to learn in a simple way with various activities.

CONCLUSIONS

Findings revealed that CAI has a significant effect on pupils' performance in quantitative and verbalreasoning in Lagos State, Nigeria. In other words, CAI contributed to students' performance in primary

school. There was also an indication that the use of CAI to teach quantitative and verbal made no significant difference in male and female pupils' performance. In other words, the use of CAI on pupils' performancein quantitative and verbal has nothing to do with their gender. Since the findings revealed that CAI had a significant effect on pupils' performance in quantitative and verbal reasoning in Lagos State, Nigeria. It is hereby recommended that government should provide CAI devices to all public primary schools in Lagos State. Also, Government should proffer the means of using the CAI devices (electricity). During theresearch, it was noticed that not all the schools equipped with CAI devices could use them due to theunavailability of electricity in the schools. Besides, schools that had electrical facilities also had seriouschallenges with electricity due to the situation in the country. Therefore the government should provide ameans of using the device at all times so that pupils can actually learn in a conducive environment**.** Furthermore, it was found that gender had no significant influence on the performance of students exposedto the use of CAI in teaching quantitative and verbal reasoning, therefore it is very expedient that teachershave basic CAI knowledge to enable them to teach all subjects with the device in order to take appropriatemeasures in helping pupils. Seminars should also be organized for teachers to enhance their knowledge onthe use of CAI to affect teaching and learning processes.

This research was conducted mainly on the effect of the findings of this study and since no research can be exhaustive, the following aspects are identified for further research:

The scope of this study could be expanded to take care of the limited number of schools and students used in this study. This would help to generalize the effect of CAI on pupils' performance. Further research could be carried out in other subject areas in primary schools since the present study focused only on quantitative and verbal reasoning. This would ascertain the effect of Information Communication Technology on pupils' performance in other subject areas. Similar research covering both private and public schools could be conducted since the present study covered only public primary schools. This will further enhance the generalizability of the findings.

REFERENCES

1. Alade, I.A. (2011) Trends and issues on curriculum review in Nigeria and the need for paradigm shift in educational practice, *Journal of Emerging Trends in Educational Research and Policy Studies, vol. 2,* pp. 325-333. Retrieved from http://jeteraps.scholar linkresearch. com/ articles /eduucational .pdf
2. Angelo, T. A. (1995). Beginning the dialogue: Thoughts on promoting critical thinking: Classroom assessment for critical thinking. *Teaching of Psychology, 22*(1), 6-7.
3. Attridge, N. &Inglis, M., (2013). *Advanced mathematical study and the development of conditional reasoning skills*. *PLoS ONE*, 8, e69399.
4. Barak, M., Ben-Chaim, D. &Zoller, U. (2007). Purposely teaching for the promotion of higher-order thinking skills: A case of critical thinking. *Research Science Education, 37*, 353-369.
5. Ben-Chaim, D., Ron, S., Zoller, U., Pentimalli, R., &Borsese, A. (2000). The disposition toward critical thinking of high school and university science students: An interintra Israeli-Italian *International Journal of Science Education, 22*(6), 571-582.
6. Brown, B. W. & Liedholm, C. E. (2002). Can Web Courses Replace the Classroom in Principles of Microeconomics? *American Economic Review*, (Papers and Proceedings), 92(2), 444-448.
7. Burton, N. W., & Ramist, L. (2001). *Predicting success in college: SAT studies of classes graduating since 1980 (College Board Research Rep. No. 2001-2)*. New York: The College Board.
8. Cragg, L. & Gilmore, C. (2014). Skills underlying mathematics: The role of executive function skills in the development of mathematics proficiency. Trends in Neuroscience and Education, 3, 63-68.
9. Federal Republic of Nigeria. (2014). *National Policy on Education*. Nigeria: NERDC.

10. Fuchs, T., and L. Woessmann. (2004). ‘‘Computers and Student Learning: Bivariate and Multivariate Evidence on the Availability and Use of Computers at Home and at School.’’ *CESIFO Working Paper No. 1321, 2004.*
11. Gambari, A.I., Shuaibu, A., &Shittu, A.T. (2013). Students’ Perception towards the use of computer-assisted instruction on learning mathematics in Minna, Niger State, Nigeria:
12. *International Journal of Behavioral Sciences. vol*. 4, no. 1, pp.14-21. Retrieved from https://staff.futminna .edu .ng/EDT/content/journal/PF0890/60.pdf
13. Ko, Y. & Knuth, E. J. (2013*).* Validating proofs and counterexamples across content domains:Practice of importantce for mathematics majors. *The Journal of Mathematical Behavior, 32*, 20-35.
14. Kosoko-Oyedeko, G. A & Tella, A., (2010).Teachers’ perception of the contribution of ICT to pupil’s performance in christian religious education. *Journal of social Science, vol. 22,* 1, pp. 7-14. Retrieved from http://kre publishers .com /02-Journals/JSS/JSS-22-0-000-10-Web/JSS-22-1-000-10-Abst-PDF
15. Laleye, A.M.(2019) Effects of a Computer-Programmed Instructional Strategy on Basic Science Students’ Learning Outcome in Two Instructional Settings in Ondo State, Nigeria; *International Journal of Scientific Research and Management (IJSRM).07*(02).PP.869-876. Retrieved 24/8/19 from https://pdfs.semanticscholar .org/ 034c/ c43e d667a4d efd 13de9d9436fca9b6054fc9.pdf
16. Lawal, F.K.; Ahmadu, H.O. and Dogara, M.M. (2003). The status of ICT in teaching STM in selected schools in Kano metropolis. *Proceedings of the 44th annual conference of the Science Teachers Association of Nigeria (STAN).*37-40
17. Leuven, E.; M. Lindahl; Oosterbeek, H. ; and Webbink, D. (2004). *“The Effect of Extra Funding for Disadvantaged Pupils on Achievement”*. IZA Discussion Paper. No. 1122. Bonn: Institute for the Study of Labor.
18. Li, Y.; E. J. Le Boeuf; P. K. Basu; and L. H. Turner (2003). “Development of a Web-Based Mass Transfer Processes Laboratory: System Development and Implementation”. *Computer Applications in Engineering Education. Vol. 11*, no. 1, pp. 67-74.
19. National Council of Teachers of Mathematics. (2000). *Principles and standards for school mathematics.* Reston, VA: Author.
20. Okebukola, P. (2013). Saving Nigeria from itself: towards redemption plan for education. A 50th anniversary lecture of faculty of education, *university of Ibadan*, Ibadan.