Comparative Effects of ICT-Integrated Learning Strategies on Spatial Reasoning Skills Among Nigerian Lower Primary School Pupils

Adeleke, A. G

Jegede, P. O.

Abstract

The study investigated the reported regressive performances of students in spatial reasoning concepts with a view to promote early spatial reasoning of lower primary school pupils across ability levels and sex. Non-equivalent experimental research design was employed. A hundred and five (105) pupils in four intact classes were exposed to six weeks intervention and subsequently post-tested. Data collected were analyzed using Analysis of Covariance. The study found significant effect of treatment on the performance of study participants in the ICT-integrated Think-Pair-Share treatment group. No significant interactive effect of ability was found though, the pupils of low-ability group benefitted more from the intervention (M = 12.32, 11.07; SD = 2.86, 2.98). There was no significant different of intervention between boys and girls across strategies and abilities. The study concluded that, while ICT-integrated learning strategies could improve output in spatial concepts of pupils at the primary school level, performances on the basis of sex-groups and ability groups have no significant interaction effect on the learners of spatial reasoning.

Keywords: *performance, spatial reasoning, treatment, strategies, ability group, think-pair-share, concrete-representation-abstract, learners'-self-controlled*.

INTRODUCTION

Early graft of mathematic ability has been ascertained to predict later mathematical achievement and related endeavors in life [6]. Hence, the promotion of early mathematic competency is of critical importance. Established link between spatial ability and mathematics in early childhood by neuropsychological and brain imaging studies and behavioral evidences potent that math performance can be improved with spatial reasoning. Nigeria's experience in local, national and international examinations show dwindling performances of examinees traceable to substantiated inefficient score in spatial reasoning items consistently featured [5, 1] in such standardized examinations. This was interpreted to mean that, children understanding of space pattern is necessary and demanded by the curriculum. The advent of information and communication technology (ICT) eulogized as potentially powerful and enabling tool for education change and reform is hereby engaged in learning delivery for comparative analysis of performance in learning spatial concepts among primary school pupils.

METHODOLOGY

Non-equivalent pretest, posttest and control group research design was adopted. The population consisted of 357,533 pupils' enrolled in 1, 378 primary schools in Osun State (Daily Independent, 2013) characterized with male and female learners of varied academic abilities. Study sample was eked out using purposive and multi-stage sampling techniques. Primary III class was purposively selected based on the learners' age (6 – 8 years) limit in early childhood. Four schools with 105 intact class pupils were multi-stage sampled in the three major towns of the state considering available facilities for the study. Research instruments included Spatial Reasoning for Children (SpatReC), an interactive, multimedia package designed using C-Sharp (C#) programming language and follows the taxonomy based on Benjamin Blooms' principles as revised by Anderson and Krathwohl in [8]; and Spatial Reasoning Test (SRT) used for pretest and posttest.

Instruments, in a previous study [1] were adjudged validity and reliable. Learners in their intact classes were randomly assigned to study conditions namely; the three experimental groups and the one control group; three levels of cognitive ability groups - high, medium and low; and two sex groups - male and female. The intervention took forty minutes of Mathematics periods for three days in a week and six weeks in each of the schools excluding tests.

ANALYSIS:

Tests for significant interaction effect of treatment on groups were conducted. Result shows the test of equality of means to be significantly equal (t = 2.003, p < 0.05) in favor of equal variance assumed. The study's subjects were thus adjudged to be reliably homogeneous (Table 1).

Table 1: Test for Difference in the Participating group's Post-test Scores

	t-test for Equality of Means						
	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
						Lower	Upper
Equal variances assumed	2.003	103	.048	1.253	.626	.012	2.494

Furthermore, the post-test scores of the research participants were subjected to a test of difference via analysis of covariance using their experimental groups as the differentiating variable and the pre-test scores as the covariate to remove the possible effect of previous learning and other confounds. The result showed significant difference in the post-test scores (F = 2.934, p < .05). It also showed from the table that, the R-squared value was 0.080 and the Adjusted R squared value stood at 0.053. This can be interpreted to mean that the maximum variance in the post test score is quite small. So other possible factors which might explain the difference in the post test scores and interact with the effectiveness of the learning strategies were sought after (Table 2).

Table 2:   Post-Test of Difference of Treatments

ween-Subjects Effects - Dependent Variable: post test score					
Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	96.677[a]	3	32.226	2.934	.037
Intercept	34388.204	1	34388.204	3131.034	.000
GRP	96.677	3	32.226	2.934	.037
R Squared = .080 (Adjusted R Squared = .053)					

The source of difference was located between the CRTL group and the CRA group (Table 3). It can be concluded that there exists significant difference among the learning strategies in improving performances.

ISSN 2601-8616 (print)
ISSN 2601-8624 (online)

European Journal of
Education

January-April 2020
Volume 3, Issue 1

Table 3: Multiple Comparisons Post hoc Test

Dependent Variable: post-test score Tukey HSD						
(I) Treatment	(J) Treatment	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
CTRL	TPS	.413	.924	.970	-2.00	2.83
	LSC	.514	.960	.950	-1.99	3.02
	CRA	2.514*	.960	.049	.01	5.02
* The mean difference is significant at the 0.05 level.						

Would there be any interactive effect of intervention between various academic ability pupils by virtue of learning strategies? To answer this question, the post-test scores of the research participants were subjected to a test of difference via analysis of covariance. Result shown in Table 4 revealed that there is no significant interaction effect of experimental groupings and ability levels on the post-test scores (F = 1.440, p > .05). In this stance therefore, the research question is answerable in the negative.

Table 4:   Test of Difference of Treatment and Ability in Post-test

Tests of Between-Subjects Effects Dependent Variable: post test score					
Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	113.502[a]	7	16.215	1.440	.198
Intercept	28102.188	1	28102.188	2495.206	.000
GRP * ability	113.502	7	16.215	1.440	.198
a. R Squared = .094 (Adjusted R Squared = .029)					

Lastly, could any difference in performance result from variation in sexes? Despite the slight differences in group sizes, no significant difference in the performance on the basis of sex-groups (value = 0.186, > 0.05) was found. It as well showed that, there was no significant interaction found between groups and sex in describing performance of pupils in spatial reasoning (F = 0.030, p > 0.05) (Table5).

Table 5: Test of Difference on Post-test in Treatment / Sex Groups

Descriptive										
Post test score										
	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Min.	Max.	df	f	sig

ISSN 2601-8616 (print)
ISSN 2601-8624 (online)

European Journal of
Education

January-April 2020
Volume 3, Issue 1

					Lower Bound	Upper Bound					
Male	41	18.15	3.190	.498	17.14	19.15	11	28	1	.030	.862
Female	64	18.27	3.560	.445	17.38	19.15	12	26	103		
Total	105	18.22	3.405	.332	17.56	18.88	11	28	104		

DISCUSSION & CONCLUSION:

The application of ICT unto learning strategies was with a view to improve performance in spatial concepts in pupils of low and high ability at the primary school level. Notable results included significant effect of treatment on performance at the removal of possible effect of previous learning and other confounds. This discovery agrees with [3] whose study established that particular intervention in the experimental group might increase learner's motivation and in turn lead to higher achievement levels for learners in the experimental group than for those in the control group. [2, 4] also found particular learning strategies - conceptual learning strategy and online tool substantially increasing math performance growth in separate studies.

Ability levels' effect on academic achievement as investigated indicated no significance in the post-test scores even after controlling for the previous learning through the pre-test. This result was at variance to [7] study on game-based learning (GBL) which found that, many students with low confidence toward learning mathematics can be restored and improve their confidence toward mathematics. Conclusively, performances on the basis of sex-groups and ability groups have no significant interaction found between ICT-integrated strategy learners of spatial reasoning.

REFERENCES

Adeleke, A. G. (2015) Comparative Effectiveness of ICT-Integrated Learners'-Self-Controlled, Concrete-Representational-Abstract and Think-Pair-Share Strategies in Enhancing Spatial reasoning Skills of Primary School Pupils in Osun State. A Doctoral Dissertation Submitted to Postgraduate College, Obafemi Awolowo University, Ile-Ife, Nigeria.

Adeleke, M. A. (2007) Strategic Improvement of Mathematical Problem-solving Performance of Secondary School Students using Procedural and Conceptual Learning Strategies. Educational Research and Review Vol. 2 (9), pp.259-263.

Alrabai, F. (2014) The Effects of Teachers' In-Class Motivational Intervention on Learners' EFL Achievement. Applied Linguistics. 2014 Oxford University Press.

Haelermans, C. & Ghysels, J. (2014) The Effect of an Individualized Online Practice Tool on Math Performance - Evidence from a Randomized Field Experiment.

Jegede, P. O., Adelodun, O. A. & Okoli, B. C. (1998) Evaluation of Test Characteristics of UME Mathematics Items in the Context of Bloom's Taxonomic Categories. Journal of Creativity in Teaching for the Acquisition and Dissemination of Effective Learning (CITADEL) Vol.3 (6) pp.233-241.

Krajewski, K & Schneider, W. (2009) Early development of quantity to number-word linkage as a precursor of mathematical school achievement and mathematical difficulties: Findings from a four-year longitudinal study. Learning and Instruction, 19(6), 513-526.

Ku, O., Chen, S.-Y., Wu, D.-H., Lao, A.-C.-C., & Chan, T.-W. (2014). The Effects of Game-Based Learning on Mathematical Confidence and Performance: High Ability vs. Low Ability. Educational Technology & Society, 17 (3), 65–78.

Wilson, L. O. (2013) Understanding the New Version of Bloom's Taxonomy - A succinct discussion of the revisions of Bloom's classic cognitive taxonomy by Anderson and Krathwohl and how to use them effectively. Available at http://www4.uwsp.edu/education/ lwilson/curric/newtaxonomy.htm