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EFFECT OF PARTITIVE VARIATION TEACHING STRATEGY ON PUPIL'S MOTIVATION AND PERFORMANCE IN BASIC SCHOOL ALGEBRA IN BENUE STATE, NIGERIA

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ABSTRACT

This study investigated the effect of partitive variation teaching strategy on pupils' motivation and academic performance in basic five algebra in Benue state, Nigeria. The quasi experimental, pretest-posttest design was adopted for the research. Four schools were systematically selected in Zone B education zone of the state. There were 113 pupils (54 male, 59 female) in the experimental group and 141 pupils (77 male, 64 female) in the control group. Two research questions and two hypotheses guided the study. There were two instruments used for the study: the algebra performance test (APT) which was an objective test and the Algebra Motivation Questionnaire (AMQ). These were administered on the respondents before and after teaching using carefully prepared lesson plans for both groups of pupils. The experimental procedure took 6 weeks from training to completion. The data collected were analysed using SPSS for Windows analytical software. Means and standard deviations were used to answer the research questions. The multivariate analysis of covariance (MANCOVA) was used to compare the means of motivation ratings, while analysis of covariance (ANCOVA) was used to test the hypotheses at 0.05 level of significance. Findings revealed that there was statistically significant difference $F(6,490) = 44.64$; $P = 0.00 < 0.05$ in the mean motivation ratings and mean performance $F(3,245) = 43.12$; $P = 0.00 < 0.05$ between the experimental and control groups. The study concluded that the partitive variation teaching strategy motivates pupils and improves algebra performance among Basic 5 pupils.

Keywords:partitive variation, motivation, performance, algebra, Basic school

INTRODUCTION

Mathematics education undoubtedly takes center stage in a world of unending scientific and technological advancements, as human kind continually seeks answers to questions about its needs and those of the society. Countries continue to place premium on the teaching and learning of school mathematics. Students need to acquire mathematical

knowledge and skills to compete and survive in life as well contribute their own quota to their immediate society and the world at large. These skills include logical reasoning, problem solving, and the ability to think in abstract ways. The challenge in education today however, is to effectively teach students of diverse ability and different pace of learning so they are able to learn mathematics by developing positive motivation and improved performancesin mathematics learning.

Motivational theories seek to investigate what gets individuals to move towards what activities and to describe the characteristics of these activities (Pantziara&Philipou, 2015). Motivation is defined as an internal state that arouses, directs, and maintains behavior, but simply stated motivation is a reason of students' thinking in a given situation (Garut, 2011). Motivation may also be seen as a theoretical concept utilized to clarify human behaviour. It provides the motive for human beings to react and fulfill their needs (Gopalan, Bakar, Zulkifli, & Mat, 2017). The question of how to motivate students in the classroom has become a leading concern for teachers of all disciplines.

Addressing the issue of content, Iji and Omenka (2015) found that the responses of the subjects involved in their study showed poor agreement in the classifications of the mathematics concepts in algebra, number and numeration, geometry, trigonometry and statistics. The high rate of failure in public examination in Nigeria remains a huge problem to researchers, teachers and indeed all stakeholders in education. Studies have identified factors responsible for the high rates of failure to include among others, students' negative attitude to the subject, lack of qualified teachers, inadequacy of teachers, lack of necessary learning skills, specialized language of the subject and inadequate and unsuitable textbooks. Also, it has been established that there is a significant relationship between teachers' method of teaching, teachers' attitude and students' achievement in mathematics (Avong, 2013; Daso, 2013).

The variation teaching strategy which is based on the variation theory is one of those novel teaching strategies employed by mathematics teachers. Variation theory is a theory of learning and experience that

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explains how a learner might come to see, understand, or experience a given phenomenon in a certain way and why two students sitting in the same class might come to understand a concept differently. It is a necessary component in teaching in order for students to notice what is to be learned (Bussey, Orgill&Crippen, 2012; Learning Project Team of HKU, 2011; Kullberg, Kempe&Marton, 2017).

Lai and Murray (2013) opine that procedural variation is derived from three forms of problem solving in algebra: Varying a problem; extending the original problem by varying the conditions, changing the results and generalization.Partitive Variation Teaching Strategy (PVTS) is when a part or parts of a particular problem are held constant, while other parts are changed. For example, given y = 2, evaluate:

a. 5y
b. 5y – 3
c. $5y^2 – 3$
d. $5y^2)^2 – 3$

It can be used to address individual differences in the classroom by allowing students to draw upon their personal experiences and apply them in their learning (Cheng, 2016).Random Variation Teaching Strategy (RVTS) on the other hand refers to the teaching of algebra, in which cases, entire set of problems come with a varied structures.For example, given that y = 2, evaluate:

a. x + 5
b. 4x – 9
c. $3x^2 + 7$
d. 9 (x – 2)

The object of learning for both examples is to evaluate algebraic expressions by substituting letters for numbers. A mathematics pedagogy that is rooted in variation is one that purposefully provides

learners with the means to experience variation through strategically designed activities in order to create a mathematically rich learning environment that allows learners to discern the object of learning. It is defined by its critical features that must be discerned in order to constitute the meaning aimed for. So as a pedagogic approach, a pattern of variation is a useful tool for structuring teaching to make the learning of the object of learning possible (Mhlolo, 2013). This ultimately leads to improved performances as evidenced by a number of studies.

The study by Ifelunni, Ugwu, Aneke, Ibiam, Ngwoke, Ezema, Charles, Oraelosi, & Ede (2019) investigated motivation as a determinant of academic achievement of primary school pupils in Mathematics in South-East, Nigeria. A population of 357,115 primary 5 pupils in all the 5,378 public primary schools in South-East, Nigeria was used for the study. The sample for the study comprised 400 primary 5 pupils. The findings of the study revealed, among others that there is a significant correlation between intrinsic motivation and primary school pupil's academic achievement. Liu (2018) carried out a study on "Potential reciprocal relationship between motivation and achievement: A longitudinal study". It included students from 1,052 high schools across the United States. Motivation had a greater influence on follow-up mathematics achievement (0.079, $p<0.001$). Jing, Tarmizi, Bakar and Aralas (2017) investigated the effect of utilizing Variation Theory Based Strategy on students' algebraic achievement and motivation in learning algebra. The study used quasi-experimental non-equivalent control group research design and involved 56 Form Two (Secondary Two) students in two classes (28 in experimental group, 28 in control group) in Malaysia. Result from analysis of covariance (ANCOVA) indicated that the experimental group students achieved significantly better test scores than the control group. In addition, result of Multivariate Analysis of Variance (MANOVA) also showed evidences of significant effect of VTBS on experimental students' overall motivation. These results suggested the utilization of VTBS would improve students' learning in algebra. Effect of integrated curriculum delivery strategy on

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secondary school students' achievement and retention in Algebra in Benue state was experimented by Anyor and Iji (2010). The population comprised 1,368 Senior Secondary 1 students out of which 149 were purposively sampled. The study found among other things that Integrated Curriculum Delivery Strategy (ICDS) enhanced students' achievement and retention in algebra taught during the course of the study. The ICDS highlighted the importance of creativity which is akin to the partitive variation teaching strategy, in the teaching and learning of algebra in schools. These empirical studies provided gaps and conclusions which were further investigated in the present study.

The following research questions guided the study:

i. What is the effect of the PVTS on the mean motivation ratings of Basic 5 pupils as compared to those taught using the RVTS?
ii. What is the effect of the PVTS on the mean algebraic performance of Basic 5pupils as compared to those taught using RVTS?

Two corresponding null hypotheses were formulated and tested at 0.05 level of significance:

i. There is no significant effect of the PVTS on the mean motivation ratings of Basic 5 pupils as compared to those taught using the RVTS.
ii. There is no significant effect of the PVTS on the mean algebraic performance of Basic 5pupils as compared to those taught using RVTS.

MATERIAL AND METHODS

The quasi experimental, pretest-posttest, control group design is adopted for the study. This design is seen as suitable due to the inability to manipulate and randomize the respondents who were primary school pupils studying in Basic Five. Denga (2017) posited that quasi-experimental studies are conducted under conditions that do not permit control, manipulation of variables or random selection. Random assignment can be achieved but the intact groups coupled with administrative constraints (random selection may lead to a disruption

of school organization and classes) do not allow randomization, control or manipulation. It is an investigation of the effectiveness of a teaching method where random selection of subjects is not possible being a good example, in this study, the Partitive Variation Teaching Strategy.

The area of study is Benue Education Zone B, also called Benue North West Senatorial Zone. The population comprised20,895 pupils from 1,804 primary schools in Zone B education zone of Benue state (SUBEB, Makurdi, 2019). The sample for this study was 254 pupils. There was a total of 113 pupils (54 male and 59 female) in the experimental group, while the control group had 141 pupils (77 male and 64 female).

Procedure Methodology

The study made use of 2 instruments: Algebra Motivation Questionnaire (AMQ) and the Algebra Performance Test (APT). The AMQ was a 30-item motivation questionnaire containing both pleasant (positively skewed) and unpleasant (negatively skewed) items, designed by the researcher. The Algebra Performance Test (APT) was a 20-item test set by the researcher. There were 2 sets of lesson plans for the research in each sub-topic treated, one for the Partitive Variation Teaching Strategy (experimental group) and the other for the Random Variation Teaching Strategy (control group). Some lesson plans were for a period of 1 hour, while others were for 30 minutes.

Statistical Analysis

The means and standard deviations of the variables studied were used to answer the research questions. The Analysis of Covariance (ANCOVA) was used to test the hypotheses relating to students' algebraic performance. Motivation on the other hand, was analysed using Multivariate Analysis of Covariance (MANCOVA) with data obtained from the AMQ. Both hypotheses were tested at 0.05 level of significance.

RESULT

The data is presented according to the objectives of the study. This is done by placing data for a research questions first and followed immediately by the corresponding hypothesis.

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Research question one: What is the effect of PVTS on the mean ratings of Basic 5 pupils' motivation as compared to those taught using the RVTS?

Table 1:Descriptive statistics for mean motivation ratings in the experimental and control groups

		Experimental (N = 113)		Control (N = 141)	
	Motivation	Mean	Std. Dev.	Mean	Std. Dev.
Posttest	Attention	3.62	0.25	2.26	0.38
	Relevance	3.29	0.34	2.73	0.38
	Confidence	3.04	0.42	2.85	0.43
	Satisfaction	3.10	0.44	2.86	0.37
	Interest	3.22	0.35	2.71	0.41
	Total	**3.26**	**0.42**	**2.68**	**0.45**
Pretest	Attention	2.49	0.37	2.36	0.32
	Relevance	2.84	0.35	2.56	0.30
	Confidence	2.94	0.43	2.90	0.42
	Satisfaction	2.91	0.42	2.83	0.43
	Interest	2.94	0.41	2.67	0.37
	Total	**2.83**	**0.43**	**2.66**	**0.42**

Results in *Table 1* display the means and standard deviations of the responses with respect to motivation of pupils in the experimental and control groups. It reveals that in the experimental group, the pupils consistently improved individually and in the total means (2.83 to 3.26) while the standard deviation got smaller from 0.43 to 0.42 which shows an improvement in the data distribution across the sub-scales of attention, relevance, confidence, satisfaction and interest. Results in the table also illustrate the means and standard deviations of the responses with respect to motivation of pupils in the control group. It reveals that the pupils appear to have responded in a similar fashion individually and in the total means (2.66 and 2.68). The standard deviations were 0.42 and 0.45 across the sub-scales of attention, relevance, confidence, satisfaction and interest. The standard deviations in both groups showed elements of homogeneity in their responses.

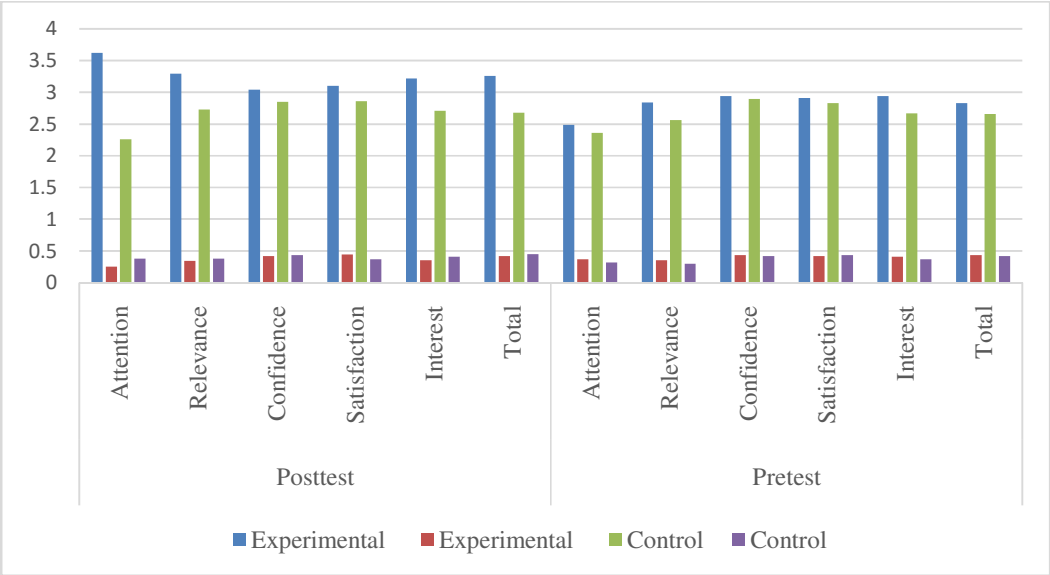

Figure 1: Bar chart for mean motivation ratings in the experimental and control groups

The figure is a pictorial representation of Table 1. It displays the means and standard deviations of the experimental group in blue and red respectively, while the means and standard deviations of the control group are displayed in green and purple respectively.

Table 2: Descriptive statistics for the motivation responses of pupils in the four sub-groups

	Group	Mean	Std. Deviation	N
Posttest	Experimental1	3.26	0.22	71
	Experimental2	3.25	0.19	42
	Control1	2.68	0.27	34
	Control2	2.68	0.27	107
Pretest	Experimental1	2.81	0.28	71
	Experimental2	2.86	0.24	42
	Control1	2.67	0.25	34
	Control2	2.66	0.24	107

Results in Table 2 show that the mean responses of the pupils in Experimental Group One increased from 2.81 in the pretest to 3.26 in the posttest, with standard deviations of 0.28 and 0.22 respectively. In the Experimental Group Two, the pupils had a mean response on 2.86 in the pretest and increased to 3.25 in the posttest, with standard deviations of 0.24 and 0.19 respectively. In the Control Group One, the

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pupils had mean response of 2.67 in the pretest and 2.68 in the posttest with standard deviations of 0.25 and 0.27 respectively. The mean response of the pupils in Control Group Two was 2.66 with a standard deviation of 0.24, in the pretest and mean of 2.68 and standard deviation of 0.27 in the posttest, this demonstrated an almost static response in the control group.

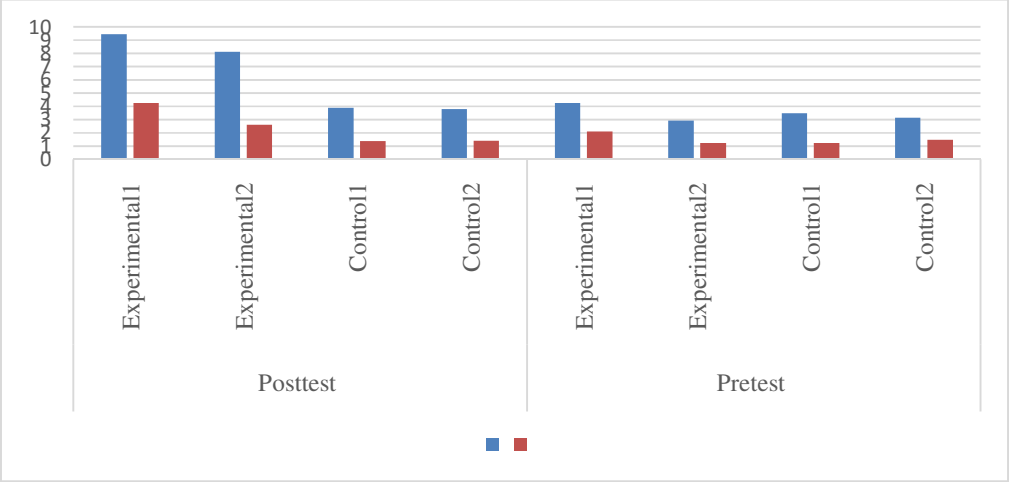

Figure 2: Bar chart for the motivation responses of pupils in the four sub-groups

The bar chart in *Figure 2* illustrates the mean and standard deviations of the mean motivation ratings of the pupils in the experimental and control groups as individual groups.

Table 3:Summary descriptive statistics for mean motivation ratings according to the experimental and control groups

		Pretest		Posttest		
Group	N	Mean	S.D.	Mean	S.D.	Mean Gain
Experimental	113	2.83	0.43	3.26	0.42	0.43
Control	141	2.66	0.42	2.68	0.45	0.02
Mean difference		**0.17**		**0.58**		**0.41**

The experimental and control groups had a mean motivation rating of 2.83 and 2.66 in the pretest respectively with a mean difference of 0.17 in favour of the experimental group. The data also showed that the pupils in the two groups had corresponding means of 3.26 and 2.68 in the posttest, this gave a mean difference of 0.58, also in favour of the

experimental group. There was a mean gain of 0.43 for the experimental group to the control group's mean gain of 0.02, which gave rise to a mean gain difference between the groups of 0.41. The standard deviation for the experimental group (0.42) was smaller than those of the control group (0.45) in the posttest; this indicates that the responses of the pupils in the experimental group were more homogenous than those in the control group. This depicts a positive effect of the PVTS motivation of pupils in learning algebra among the sample of pupils, to answer the research question.

Hypothesis one: There is no significant effect of the PVTS on the mean motivation ratings of Basic 5 pupils as compared to those taught using the RVTS

Table 4:Summary of multivariate tests for mean motivation ratings between the experimental and control groups

Effect		Value	F	Hypothesis df	Error df	Sig.
Groups	Pillai's Trace	0.59	33.94	6	492	0.00
	Wilks' Lambda	**0.42**	**44.64**	**6**	**490**	**0.00**
	Hotelling's Trace	1.38	56.26	6	488	0.00
	Roy's Largest Root	1.38	112.93	3	246	0.00

The data is interpreted using Wilks' Lambda, the recommended measure (Lund & Lund, 2020) for a multivariate statistic (MANCOVA) for the study. Data in *Table 4* shows that there is a statistically significant difference $F(6, 490) = 44.64$ and $p = 0.00 < 0.05$ in the mean motivation rating of the respondents. The research hypothesis one is therefore rejected, which implies that the mean motivation ratings of pupils taught using the PVTS differ significantly from those taught using the RVTS. This suggests that the pupils showed greater attention, relevance, confidence, satisfaction and interest in the learning of algebra when taught using the intervention strategy.

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Research question two: What is the effect of the PVTS on the mean score of Basic 5 pupils' algebraic performance as compared to those exposed to RVTS?

Table 5:Descriptive statistics showing the mean scores at APT in the experimental and control groups in terms of the four sub-groups

	Group	Mean	Std. Deviation	N
Posttest	Experimental1	18.99	7.74	71
	Experimental2	21.05	9.95	42
	Control1	9.82	3.79	34
	Control2	9.81	3.69	107
Pretest	Experimental1	11.10	5.70	71
	Experimental2	8.86	2.58	42
	Control1	8.38	3.04	34
	Control2	7.48	3.54	107

Results in Table 5 reveal the means and standard deviations of the 4 sub-groups in terms of the algebra performance test. The Experimental Group One had a mean of 11.10 in the pretest with a standard deviation of 5.70 and a mean of 18.99 and standard deviation of 7.74. The Experimental Group Two had a mean of 8.86 and 21.05 in the pretest and posttest respectively, with standard deviations of 2.58 and 9.45. The Control Group One had a mean of 8.38 in the pretest and 9.82 in the posttest, with standard deviations of 3.04 and 3.79 respectively. The Control Group Two had a mean of 7.48 in the pretest and 9.81 in the posttest, with corresponding standard deviations of 3.54 and 3.69 respectively. On the whole, the two groups demonstrated similar data characteristics going by their standard deviations. However, there appears to be a disproportionate data behaviour in Experimental Group Two, where the standard deviation in the posttest appears abnormal to the other results in relation to the mean and total number of respondents.

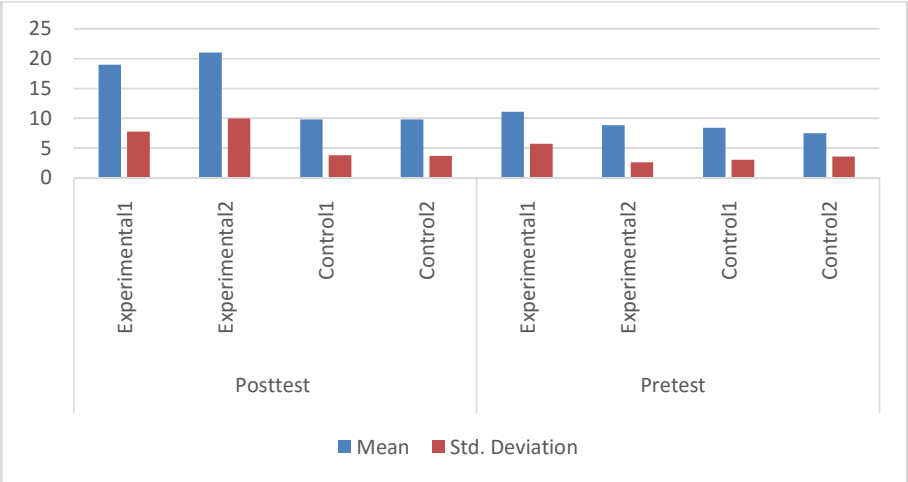

Figure 3: Bar chart showing the mean scores at APT in the experimental and control groups in terms of the four sub-groups

The means in blue and standard deviations in red illustrate the scores of pupils in the groups with respect to the pretest and posttest performance.

Table 6: Summary descriptive statistics showing the mean difference between the experimental and control group at APT

		Pretest		Posttest		
Group	N	Mean	S.D.	Mean	S.D.	Mean Gain
Experimental	113	9.98	4.14	20.02	8.85	10.04
Control	141	7.93	3.29	9.82	3.74	1.89
Mean difference		**2.05**		**10.20**		**8.15**

Results in *Table 6* shows that pupils in the experimental group had a mean of 9.98 and 20.02 and standard deviation of 4.14 and 8.85 in the pretest and posttest respectively; this gives a mean gain of 10.04 for the experimental group. The control group on the other hand had a mean performance score of 7.93 and 9.82 with standard deviations of 3.29 and 3.74 in the pretest and posttest respectively with a mean gain of 1.89. There was a mean difference of 2.05 and 10.20 in the pretest and posttest, and 8.15 in the mean gain. The standard deviations of the two groups are an indication that the data sets share similar traits, because they fall within the same side and partition of the normal curve. To answer the research question, the PVTS appears to have caused an increased algebraic performance in the APT by pupils in the

experimental group as compared to pupils that were taught using the RVTS.

Hypothesis two: The PVTS has no significant effect on Basic 5 pupils' algebra performance mean score as compared to those taught using the RVTS.

Table 7: Summary tests of between-subjects (experimental and control groups) effects with respect to the APT using posttest as the dependent variable

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	7433.87	8	929.23	25.18	0.00
Intercept	4701.44	1	4701.44	127.42	0.00
APTpretest	939.46	1	939.46	25.46	0.00
Gender	54.74	1	54.74	1.48	0.22
APT	4773.41	3	1591.14	43.12	0.00
Gender * APT	157.16	3	52.39	1.42	0.24
Error	9039.95	245	36.90		
Total	67952.00	254			
Corrected Total	16473.83	253			

The analysis shown in *Table 7* reveal that there was a statistically significant effect, where $F(3, 245) = 43.12$ and $P = 0.00 < 0.05$ of the PVTS when compared to the RVTS in the mean performance scores of pupils. The null hypothesis is rejected which implies that the PVTS has a significant effect on Basic 5 pupils' algebra performance mean score as compared to those taught using the RVTS.

DISCUSSION

This study found a significant difference in the mean motivation ratings of pupils in the experimental group and the control group in favour of the experimental group which agrees with Jing, Tarmizi, Bakar and Aralas (2017).The findings also agree withYakubu (2017) who found that pupils with mathematics learning challenge in the treatment group showed higher motivation than pupils in the control group. There were evidences of significant effect of the partitive variation theory-based strategy on experimental students' overall motivation. This indicated that the partitive variation teaching strategy may be capable of triggering both the intrinsic and extrinsic motivation of pupils in the

middle basic level of education in Benue state, Nigeria. This was made more consistent by the more improved mean motivation ratings in the 5 subscales of attention, relevance, comprehension, satisfaction and interest, which the pupils in the experimental group consistent had higher mean responses.

There was statistically significant difference in the performance of students between the experimental group and the control group, which agrees with Anyor and Iji (2010) as well as Jing, Tarmizi, Bakar and Aralas (2017). The positive interaction of organizational culture, education in this case, and human resource management (teaching) would result in self-esteem and self-actualization. Generally, it is agreed that dispositions such as motivation, curiosity and perseverance can be recognised when students persist at difficult tasks, take risks and exhibit open mindedness (Al-Shara, 2015). The findings of this study also agree withthose of Liu (2018) as well as Ifelunni, Ugwu, Aneke, Ibiam, Ngwoke, Ezema, Charles, Oraelosi, and Ede (2019) that there is a significant influence of motivation or that there is a potential reciprocal relationship between motivation and academic performance of students. García, Rodríguez, Betts, Areces and González-Castro (2016) stated that Mathematics enjoyment or satisfaction positively predicted mathematics achievement as has been confirmed in this study. Higher motivation ratings which may be due to the partitive variation teaching strategy predicatedbetter algebraic performances among Basic school learners.

CONCLUSION

This study concluded that pupils in the experimental group significantly showed higher motivation ratings and consistently outperformed those in the control group in the algebra performance test. The study further concluded that the partitive variation teaching strategy may be useful for the improvement of algebra teaching and learning in Middle Basic (Basic 5) level of education in Benue state, which may be replicated in other locations.

REFERENCES

Jing, T. J., Tarmizi, R. A., Bakar, K. A., &Aralas, D. (2017). The adoption of variation theory in the classroom: effect on students' algebraic achievement and motivation to learn. *Electronic Journal of Research in Educational Psychology*, 15(2), 307-325

Pantziara, M. &Philippou, G. N. (2015). Students' motivation in the mathematics classroom. Revealing causes and consequences. *International Journal of Science and Mathematics Education*, 13(2)

Garut, P. (2011). *Motivation in learning mathematics.* Retrieved online from https://p4mristkipgarut.wordpress.com/2011/05/03/motivation-in-learning-mathematics/ on 12th February, 2018

Gopalan, V., Bakar, J. A. A., Zulkifli, A. N., Alwi, A. & Mat, R. C. (2017). *A review of the motivation theories in learning*. Malaysia: AIP Publishing

Iji, C. O. &Omenka, J. E (2015). Mathematics teachers' perception of difficult concepts in secondary school mathematics curriculum in Benue state, Nigeria. *Asia Pacific Journal of Education, Arts and Sciences*, 2(1)

Avong, H. N. (2013). Poor performance in mathematics among senior secondary school students in Kaduna state: what's to blame? *JORIND,* 11(2).

Daso, P. O. (2013). Teacher variables and senior secondary students' achievement in mathematics in Rivers state, Nigeria. *European Scientific Journal,* 9(10), 1857 – 7881

Bussey, T. J., Orgill, M. &Crippen, K. J. (2013). *Variation theory: A theory of learning and a useful theoretical framework for chemical education research.* The Royal Society of Chemistry,University of Florida, School of Teaching and Learning, Gainesville, USA

Learning Project Team of HKU (2011). What teachers should know about learning theories. Retrieved online from https://kb.edu.hku.hk/approaches_variation_theory/ on 22nd March, 2018

Jerome, N. (2013)Application of the Maslow's hierarchy of need theory;impacts and implications on organizational culture, human resource and employee's performance. International Journal of Business and Management Invention, 2(3), 39-48

Kullberg, A., Kempe, U. R. &Marton, F. (2017). What is made possible to learn when using the variation theory of learning in teaching mathematics? *ZDM Mathematics Education*, 49:559–569

Lai, M. Y. & Murray, S. (2013). Teaching with Procedural Variation: A Chinese Way of Promoting Deep Understanding of Mathematics. Retrieved online from www.researchoutput.csu.edu

Cheng, E. W. L (2016). Learning through the Variation Theory: A Case Study. *International Journal of Teaching and Learning in Higher Education*, 28(2), 283-292

Mhlolo, M. (2013). The merits of teaching mathematics with variation. *Pythagoras*, 34(2), Art. #233, 8 pages. http://dx.doi.org/10.4102/pythagoras.34i2.233

Anyor, J. W. &Iji, C. O. (2010). Effect of integrated curriculum delivery strategy on secondary school students' achievement and retention in Algebra in Benue state. *Abacus, journal of the Mathematical Association of Nigeria (MAN)*, 39(1), 83-96

Denga, D. I. (2017). *An introduction to research methods and statistics in education and social studies (4th).*Calabar: Clearlines Publications Limited

Lund, A. & Lund, M. (2020). *Two-way ANCOVA in SPSS.* Retrieved online from www.statistics.laerd.com/spss-tutorials/two-way-ancova-using-spss-statistics.php

Yakubu, I. W. (2017). *Effect of inclusion instructional strategy on motivation and achievement of Middle Basic pupils with mathematics learning challenge in Benue state.* A thesis in the department of Curriculum and Teaching, Benue state University, Makurdi

Mata, M. L., Monteiro, V. &Peixoto, F. (2012). Attitudes towards mathematics: Effects of individual, motivational, and social support factors. *ChildDevelopment Research, Volume 2012, Article ID 876028*, 10 pages

Al-Shara, I. (2015). Learning and teaching between enjoyment and boredom as realized by the students: a survey from the educational field. *European Scientific Journal* edition, 11(19), 146-168

Liu, Y. &Hou, S. (2018). Potential reciprocal relationship between motivation and achievement: A longitudinal study. *School Psychology International*, 3(2), 38–55

Ifelunni, C. O., Ugwu, G. C., Aneke, A. O., Ibiam, J. U., Ngwoke, A. N., Ezema, V. S., Charles A. Oraelosi, C. A. & Ede, M. (2019). Motivation as a Differential Predictor of Mathematics Achievement of Pupils in South-East, Nigeria. *Journal of Engineering and Applied Sciences, 14: 5345-5350*

García, T., Rodríguez, C., Betts, L., Areces, D., & González-Castro, P. (2016). How affective-motivational variables and approaches to learning relate to mathematics achievement in upper elementary levels. *Learning and Individual Differences*, 49, 25-31.