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Number Manipulation Strategy: A Model of Experiential Instruction and Interest in Arithmetic Learning of Pupils of Lower Basic Level in Enugu State, Nigeria

Sochima Stanislus Unodiaku
Department of Mathematics & Computer Education, Enugu State University of Science and Technology (ESUT), Enugu, Enugu State, Nigeria
unodiakustanley@gmail.com

Abstract: The study investigated the efficacy of the number manipulation strategy (NUMAS) as a model of experiential instruction and interest in arithmetic learning for pupils of lower basic levels. The population of the study consisted of 1205 lower basic III level pupils of the 2018/2019 session in Igbo-Etiti Local Government Area (L.G.A.) of Enugu State. A sample of 121 primary five pupils from 4 schools out of 53 primary schools in the study area was randomly sampled. The 121 pupils were composed of 42 males and 79 females used for the study. The study was guided by four research questions and four hypotheses. The hypotheses were tested at a p<.05 level of significance. The instruments used for the study were Arithmetic Test (ART) and Mathematics Interest Inventory Questionnaire (MIIQ) developed by the researcher. The ART and MIIQ instruments were faces validated by experts and their reliability indexes were 0.85 and 0.79 respectively, established using Cronbach alpha and split-half methods respectively. The data obtained with the instruments were analyzed using mean, standard deviations (SD), t-test and analysis of covariance (ANCOVA) statistics. Mean and SD was used in answering the research questions, while t-test and ANCOVA statistics were used in testing the hypotheses at P<.05 level of significance. The findings of the study showed that NUMAS is effective in teaching arithmetic, especially in enhancing the addition and subtraction skills acquisition of the pupils. Gender was found not to be a significant factor of variance in arithmetic achievement when the teaching of arithmetic is NUMAS based. The use of NUMAS was recommended to teachers, lower basic mathematics textbook authors and stakeholders in education, to ensure that NUMAS is adopted and adapted for use in Mathematics classroom instruction and learning.

Keywords: *Mathematics, Number-manipulation, strategy, interest and Arithmetic.*

1. Introduction

The National Policy on Education clearly stated that the objectives of primary education include, "providing opportunities for the child to develop life manipulative skills that will enable the child to function effectively in the society within the limits of the child's capability," (FRN, 2013, P. 18). Invariably, enhancing mathematics teaching and learning that can provide the child opportunities to develop his/her life-long manipulative skills becomes imperative. This is so because certain qualities that are nurtured by mathematics are the power of reasoning, creativity, abstract or spatial thinking, critical thinking, problem-solving ability and even effective communication skills (Guwahati News-Times, 2015). Ideally, Mathematics introduced children to concepts, skills and thinking strategies that are essential in everyday life and support learning across the curriculum (RetrSagepub, 2019). The above assertions, all suggest that Mathematics should be taught to the child from the early school-age/infant classes or foundational level of the child's schooling.

For instance, Unodiaku (2016) noted that a poor foundation for acquiring Mathematics knowledge in the infant classes is one of the major causes of poor performance of students in Mathematics at their later years of schooling. Unodiaku (2016) insisted that the right foundation of Mathematics instruction should be laid right from the infant classes and therefore it is vital that the teaching of numbers should be on the right lines from the very start of formal education of learners because failure to acquire this fundamental background knowledge of Mathematics at the early stages would eventually lead to backwardness in Mathematics in later years (Unodiaku, 2016). Obviously, primary school pupils are finding Mathematics difficult to learn leading to their poor performance on the subject both previously and presently. For instance, the trend of pupils' poor performance in Mathematics is conspicuously evidenced in the years, 2010-2016, as reported in National Common Entrance Examination (NCEE), NECO examination which revealed dwindling and stagnating increase in percentage pass at credit level in Mathematics among the examinees as shown in Table 1 below:

Table 1: Frequency Count and Percentage Pass at Pupils in NCEEE Level of Performance of Pupils in Mathematics from 2010-2015

Year	% Pass at Credit Level
2010	13.63%
2011	23.67%
2012	24.47%
2013	24.39%
2014	39.06%
2015	34.15%

Source: Quality Assurance Development, NECO, Mina, Niger State Nigeria, 2017.

Poor performance in Mathematics is on the increase, the incessant low performance if pupils in primary Mathematics suggest that either the pupils lack interest in the subject or teachers failed to use appropriate methods/strategies to teach the subject. The situation calls for a closer check on how the subject is taught to pupils. There is a need for the check because of incessant reports on students' poor performance in Mathematics in the late years of their schooling (at secondary school level) is a clear indication that the problem is associated with poor teaching methods/appropriate strategies used in teaching and learning of the subject as well as pupils' lack of interest on the subject at the foundational level. For instance, Norman (2014), and Unodiaku (2016), all attributed pupils' poor performance in Mathematics to poor teaching methods used by teachers which contributed to pupils' loss of interest in the subject. According to the use of the appropriate method of teaching, negative attitude towards Mathematics and ineffectiveness of Mathematics teachers are also responsible for poor performance and loss of interest of pupils in learning Mathematics. Unodiaku (2016) pointed out that teachers should use teaching materials that pupils are familiar with and can handle if they must capture the interest of the pupils. The use of appropriate teaching methods, materials and/or strategies to teach Mathematics concepts arouses pupils' interest and increases the volume of learned materials (Unodiaku, 2018).

One other factor responsible for pupils' poor performance in Mathematics is that the current Nigeria Certificate in Education (NCE) program for lower and middle basic education has a low content of Mathematics and so does not prepare teachers adequately for the teaching of Mathematics after the training. This is because Mathematics is just one of the numerous subjects that are offered by pre-service primary teachers in Colleges of Education, and only four courses – PED 113 Mathematics in primary education and PED 122 Mathematics in primary education 1; PED 222 Mathematics in primary education II; PED 324 Mathematics in primary education III; each of which has 2 credit units that are offered throughout the program duration (FRN, 2012). This low content of Mathematics in the NCE primary education program cannot give NCE teachers enough background Mathematics knowledge to teach Mathematics effectively at the primary school level. Based on the foregoing, the present state of the art in Mathematics instruction and learning at the foundation level, suggest that Mathematics teachers are yet to embrace strategies that are capable of capturing pupils' interest in Mathematics and hence deterred their achievement on the subject at late years of schooling. The need to develop in the child manipulative skills that can enhance the child function effectively at later years in the society make this research worthwhile. Isaac and Andrew (2014) conducted a study on the effect of a practical Approach on Basic 7 Mathematics students' interest and performance in Fraction in the Uyo Local government area of AkwaIbom State.

The result showed that students in the practical approach developed an interest that was significantly better than their counterparts in the conventional group. The population for this study is all the 1205 pupils of lower basic III level in Igbo-Etiti L.G.A. of Enugu state. More so, Hassan, Abari, Terseer, Aruwa and Ndanusa (2017) conducted research on the impact of the practical application of Mathematics on senior secondary school students' interest and achievement in Algebra in the Karu Local Government Area of Nasarawa State. The result showed that students who taught Mathematics with practical application improved on their achievement in Mathematics more than those who taught Mathematics with the conventional approach. The researchers concluded that this enhanced achievement in Mathematics is significantly associated with students' interest and gender gap. The above two research reports clearly indicated that interest is a factor of academic achievement in Mathematics and make this investigation worthwhile to determine how the use of NUMAS can develop the interest of pupils in arithmetic learning. Number manipulative strategy is a situation in which teachers apply addition and subtraction operations to manipulate chosen whole numbers to obtain a single digit 9. The strategy is targeted to support their teaching methods, buttress pupils' interest and curiosity in arithmetic learning and problem-solving. The problem of this study then is to determine the effectiveness of experiential instruction and the interest of pupils of lower basic levels. The following four research questions and four null hypotheses guided the study. The hypotheses were tested at a $p < .05$ level of significance. The research questions are:

- What are the mean achievement test scores and standard deviations (SD) of pupils taught arithmetic with NUMAS and those taught with a conventional approach?
- What are the mean achievement test scores and SD of male and female pupils in the experimental group?
- What are the pupils' opinions on how far NUMAS influences their interest in Arithmetic learning?
- What is the pupils' opinion on how far NUMAS influences their interest in arithmetic learning due to gender?

The null hypotheses are:-

H_0: There is no significant difference between the mean achievement test scores of pupils taught arithmetic with NUMAS and those taught with the conventional approach.

H_0: There is no significant difference between the mean achievement test scores of male and female pupils exposed to NUMAS.

H_0: There is no significant difference between the mean interest rating scores of pupils in Experimental (NUMAS) and control (conventional method) groups on the attainment of standard in teaching and learning of arithmetic.

H_0: There is no significant difference between the mean interest rating scores of male and female pupils exposed to NUMAS on the attainment of standard in teaching and learning of arithmetic.

2. Methodology

The design adopted for this study was a combination of survey and quasi-experimental design of non-equivalent control group, intact class design. The sample of pupils for this study was 121. The sample of this study consists of primary five pupils (42 males and 79 females) obtained from four intact classes in four randomly sampled primary schools in the study area. Two of the four sampled schools were randomly assigned to the experimental group made up of 64 pupils while the remaining two were assigned to the control group made up of 57 pupils. For this study, Arithmetic Test (ART) and Mathematics Interest Inventory Questionnaire (MIIQ) were used for data collection. The ART is a test instrument that covers addition and subtraction of 2 to 6-digits whole numbers that were taught with regard to this study. The ART is a ten (10) essay items instrument prepared for pupils of lower basic level. The MIIQ is organized into two sections (A and B). Section A solicits information on the Bio-data of the pupils while Section B solicits information that is capable of answering the research questions. The MIIQ is a four-point Likert-type scale of Strongly Agree (SA) = 4 points, Agree (A) = 3 points, Disagree (D) = 2 points, and Strongly Disagree (SA) = 1 point used to elicit information concerning the opinions of the respondents, with regards to their feelings on the teaching approach under study. The two research instruments (ART and MIIQ) developed by the researcher and validated by two experts in Measurement and Evaluation and two in Mathematics Education areas were used in data collection.

The reliability of the ART was established using the Cronbach alpha technique while MIIQ was established using the split-alpha method which gave reliability estimates of 0.84 and 0.7 respectively, which indicates that the instruments are reliable for use in the data collection. The researcher administered the pre-ART, pre-MIIQ, post-ART and post-MIIQ to all the 121 pupils in both experimental and control groups. The pre-ART, pre-MIIQ, post-ART and post-MIIQ were administered to the testees in the two groups at the same time and in their respective schools to avoid the horn thorn effect as well as to avoid discussion of the items between the subjects in experimental and control groups. The instruments were administered to the subjects directly by the pupils' teachers who were trained by the researcher and the scripts were collected back from them the same day. At the end of two weeks of teaching of the experimental group, the post-ART and post-MIIQ instruments were administered to the subjects. Each item of the test was scored 5 marks based on; correct choice of appropriate digit (1 mark); carrying out addition operation correctly (1 mark); interchanging of digits (1 mark); carrying out subtraction operation correctly (1 mark), and obtaining the single digit 9 (1 mark). Data generated with the instruments were analyzed using descriptive statistics of mean and standard deviation to answer the research questions while analysis of covariance (ANCOVA) statistic and independent-sample t-test were used to test the hypotheses at a 5% level of significance.

Instructional Model: NUMAS is composed of addition and subtraction of two to six digits whole numbers aimed to be strategically manipulated to obtain single digit 9. The NUMAS was guided by two rules:
Rule I: For any chosen number all digits should not be identical, i.e. do not choose numbers such as 11, 55, 333, 888888, etc.
Rule II: If after manipulation involving addition and subtraction operations are carried out, and a two, digits number is obtained, further addition of the two-digits number should be carried out to obtain a single-digit number 9.

Aims and Objectives of the Strategy: The strategy is aimed at achieving the following objectives:

- To determine two or more digits whole numbers through the application of addition and subtraction operations to obtain a single digit 9.
- To awaken the curiosity of the pupils in addition and subtraction of the whole number s through the number manipulation strategy.
- To encourage logical manipulation of numbers and systematic thinking.
- To remove Mathematics phobia among the pupils, thereby making Mathematics learning interesting to them.
- To encourage retention of arithmetic learning.

Lesson Plan: Both the experimental group and the conventional group (control) were taught the same unit (Addition and Subtraction of whole numbers) with the lesson plan.

Experimental Procedure: The pupils were taught the same unit (addition and subtraction of 2, 3, 4, 5 and 6 digits whole numbers) from the lower basic Mathematics curriculum (NERDC, Rev. 2012) for two weeks using four contacts of 35 minutes each week. The procedure of the NUMAS was organized into 5 phases with each phase further organized into steps.

Phase 1: Manipulation of 2 digits whole numbers to obtain a single digit 9.
Step 1: The teacher told the pupils to choose any two numbers provided the two numbers are not identical (observing the above rules).
Step 2: The teacher instructed them to interchange the digits of their chosen numbers. Eze interchanged his 24 and got 42 while Amaka interchanged her 85 and got 58.
Step 3: The teacher instructed them to subtract the smaller number from the larger one. Eze therefore obtained.

$$\begin{array}{rcc} & 4 & 2 \\ - & 2 & 4 \\ \hline & 1 & 8 \end{array} \qquad \text{Amaka obtained:} \quad \begin{array}{rcc} & 8 & 5 \\ - & 5 & 8 \\ \hline & 2 & 7 \end{array}$$

Step 4: The teacher instructed them to add the digits of the results they obtained. Eze therefore added his digits of 18 and obtained: 1 + 8 = 9; and Amaka add her digits 27 and obtained 2 + 7 = 9. Similar results (9) were obtained by all the pupils in the class.

Phase II: Manipulation of 3 digits whole numbers to obtain single digit 9.
Step 1: The teacher told the pupils to choose any three digits whole numbers. One of the pupils John by name chose 531 while another pupil Jane chose 490.
Step 2: The teacher told the pupils to interchange any two digits of their chosen numbers. John interchanged the first and second digits of his 531 and got 351. Jane interchanged her first and last digits of her 490 and got 094.
Step 3: The teacher instructed them to subtract the smaller number from the larger one.

$$\text{John therefore obtained} \quad \begin{array}{rccc} & 5 & 3 & 1 \\ - & 3 & 5 & 1 \\ \hline & 1 & 8 & 0 \end{array} \qquad \text{and Jane obtained} \quad \begin{array}{rccc} & 4 & 9 & 0 \\ - & 0 & 9 & 4 \\ \hline & 3 & 9 & 6 \end{array}$$

Step 4: The teacher instructed them to add the digits of their results. John added the digits of his 180 and obtained: 1 + 8 + 0 = 9. Similarly, Jane added the digits of her 396 and obtained 3 + 9 + 6 = 18.Pupils who obtained more than one digit number were told to do further addition of the digits as demanded in rule II above. Jane therefore further added the digits of her result 18 and obtained: 1 + 8 = 9. All other pupils got a similar result as 9.

Phase III: Manipulation of 4 digits whole numbers to obtain single digit 9.
Step 1: The teacher drew the attention of the pupils to the rule I above once more. All the pupils choose four-digits whole numbers obeying the rule I above. Mark choose 9350 and Ebere to chose 2158.

Step 2: The teacher instructed the pupils to interchange digits of their chosen numbers. Mark interchanged digits of his 9350 to 3905 while Ebere interchanged her 2158 to 8251. Other pupils interchanged theirs and obtained new digits as well.

Step 3: The teacher instructed them to subtract the smaller number from the larger one. Mark obtained:

9 3 5 0	While Ebere obtained:	8 2 5 1
- 3 9 0 5		- 2 1 5 8
5 4 4 5		6 0 9 3

Step 4: The teacher instructed them to add the digits of their results. Mark therefore added the digits of 5445 and obtained 5 + 4 + 4 + 5 = 18; while Ebere added the digits of her 6093 and obtained 6 + 0 + 9 + 3 = 18.

Step 5: The teacher instructed them to further add the digits of their results to obtain a single digit. Mark, therefore, added the digits of his result 18 and obtained 1 + 8 = 9. Similarly, Ebere added the digits of 18 she obtained and got 1 + 8 = 9. A similar result (9) was obtained by all other pupils in the class.

Phase IV: Manipulation of 5 digits whole numbers to obtain a single digit 9. The teacher instructed the pupils to choose any 5 digits whole numbers provided rule 1 above is strictly, adhered to. The teacher took the following steps:

Step 1: The teacher instructed the pupils to choose any 5-digits whole number of their choice provided the digits are not the same as stipulated in rule 1 above. Johnson chooses 10251, Agnes chooses 94255 and Mary chooses 82694. Other pupils in the experimental group choose different numbers as well.

Step 2: The teacher instructed them to rearrange the digits of their chosen numbers. Johnson rearrange his 10251 and got 05211; Agnes rearranged her 94255 and got 52945 while Mary's rearrangement of her 82694 gave 69824.

Step 3: The teacher instructed them to subtract the smaller number from the larger one. Johnson therefore subtracted the smaller number from the bigger and obtained

	1	0	2	5	1
	- 0	5	2	1	1
		5	0	4	0
	9	4	2	5	5
Agnes Obtained:	- 5	2	9	4	5
	4	1	3	1	0
	8	2	6	9	4
Mary Obtained:	- 6	9	8	2	4
	1	2	8	7	0

Step 4: The teacher instructed them to add the digits of the results of the subtraction. Johnson added the digits of his (5040) and obtained: 5 + 0 + 4 + 0 = 9. Agnes added the digits of her result (41310) and obtained 4 + 1 + 3 + 1 + 0 = 9. Mary added the digits of her result (12870) and obtained: 1 + 2 + 8 + 7 + 0 = 18. The teacher further drew the attention of those that obtained two-digit whole numbers to rule II above, to further add the digits. Mary therefore added her 18 and obtained 1 + 8 = 9. A similar result (9) was obtained by all other pupils exposed to the NUMAS.

Phase V: Manipulation of six digits whole numbers to obtain single digit 9. To achieve this objective, the teacher took the following steps:

Step 1: The teacher instructed the pupils in the experimental group to choose any six-digit numbers of their choice. Ifeanyi chooses 209400; Nneoma chooses 112496; Odera chooses 100025.

Step 2: The teacher instructed the pupils to interchange the digits of their chosen numbers. Ifeanyi interchanged the digits of his 209400 to 090042; Nneoma interchanged the digits of her 112496 to 911642, and Odera interchanged his 100025 to 000512.

Step 3: The teacher instructed them to subtract the smaller number from the larger one.

Ifeanyi therefore obtained:	2	0	9	4	0	0
	- 0	9	0	0	4	2
	1	1	9	3	5	8
	9	1	1	6	4	2
Neoma Obtained:	- 1	1	2	4	9	6
	7	9	9	1	4	6

	1	0	0	0	2	5
Odera Obtained:	- 0	0	0	5	1	2
		9	9	5	1	3

Step 4: The teacher instructed them to add the digits of the results. Ifeanyi therefore added the digits of his 1198358 and obtained: 1 + 1 + 9 + 8 + 3 + 5 + 8 = 27. Nneoma added her 799146 and obtained 7 + 9 + 9 + 1 + 4 + 6 = 36. Odera added his 99513 and obtained 9 + 9 + 5 + 1 + 3 = 27. The teacher drew the attention of the pupils to Rule II above.
Step 5: The teacher instructed them to further add the digits of their two-digit whole numbers to obtain a single-digit number. Ifeanyi added his 27 and obtained: 2 + 7 = 9
Nneoma added her 36 and obtained: 3 + 6 = 9
Odera added his 27 and obtained: 2 + 7= 9
Similar results (9) were obtained by all the participants in the experimental group.

Observations Made After the Experiment

- Pupils in the experimental group manipulated correctly, applying addition and subtraction operations of whole numbers, after the experiment than before as they proceeded to work on 7, 8, 9 and more digit whole numbers unassisted.
- The NUMAS has removed Mathematics phobia among the children in the experimental group as they have shown active participation in Maths classes.
- NUMAS has awakened the curiosity and interest of the pupils in learning Mathematics as they were busy participating in problem-solving activities.
- It has improved the systematic thinking of the pupils and encouraged their logical manipulation of numbers through repeated addition and subtraction operations.
- The pupils exposed to the conventional method did not show a positive attitude/interest in learning Mathematics.
- Most of them in the control group expressed fear, hatred and depression when they saw the Mathematics teacher and arithmetic topic written on the chalkboard.

3. Results

The data is presented in line with the posed research questions and the null hypotheses.

Research Question One: What are the mean achievement test scores and standard deviation of pupils taught arithmetic with the NUMAS (EXPR. Group) and those taught with the conventional method (Control group)?

Table 2: Mean and SD of Pupils Exposed to EXPR and Control groups

Teaching Method	N	Type of test	Mean ($\bar{X}$)	SD
NUMAS (Expr group)	54	Pre-ART	37.87	5.5014
		Post-ART	38.47	6.1711
		Mean diff.	0.60	
Conventional Approach (control group)	67	Pre-ART	37.88	7.6829
		Post-ART	37.76	8.4503
Mean diff.			0.12	
Grand mean Diff.			0.48	

The above results show that the mean pre-test score for the pupils exposed to NUMAS (Experimental Group) is 37.87 with an SD of 5.5014 and the mean pre-test score for the pupils exposed to the conventional method (control group) is 37.88 with an SD of 7.6829. However, the mean post-test score for the group exposed to the NUMAS is 38.47 with an SD of 6.1711 while the mean post-test score for the group exposed to the conventional approach is 37.76 with an SD of 8.4503. The grand mean difference of 0.48 in favor of the experimental group indicated that pupils in the experimental group have a higher mean score than their conventional approach group. To further determine if the observed difference in the mean scores of the pupils exposed to the two methods (NUMAS vs Conventional) are statistically significantly different, hypotheses 1 and 2 were tested at $p < .05$ level significance (see Table 4 below).

Research Question Two: What are the mean achievement test scores and SD of pupils exposed to the experimental treatment due to gender?

Table 3: Means and SD Scores of Male and Female Pupils Exposed to the Experimental Treatment

Teaching Method	Gender	Pre-test Mean	SD	Post-test Mean	SD	Mean Gain
NUMAS	male (n = 33)	5.47	1.187	6.50	2.150	1.03
	female (n = 21)	5.50	1.201	5.59	2.048	0.09
Mean diff.		0.03		0.91		

Table 3 above clearly showed that the mean and SD scores of male pupils exposed to experimental treatment in the pre-test were 5.47 and 1.187 respectively, and females' mean and SD were 5.50 and 1.201 respectively, with a mean difference of 0.03 in favor of females in the pre-test. In the post-test, the mean and SD of males in the experimental group were 6.50 and 2.150 respectively, and their females' counterparts' mean and SD were 5.59 and 2,048 respectively, with a mean difference of 0.91 in favor of males. To further determine if the observed mean difference of males and females in the pre-test and post-test are statistically significantly different, hypotheses 1 and 2 were tested at $p < .05$ significant level.

Table 4: Summary of ANCOVA Result of Pupils' Achievement Test Scores in Arithmetic

Source	Type III sum of squares	DF	M S	$F_{cal. val.}$	Sig. (p< .05)	Partial Eta Squared
Corrected model	2923.242[a]	4	730.811	28.435	.000	.597
Intercept	771.975	1	771.975	30.037	.000	.485
Pre-test	826.965	1	826.965	32.176	.000	.201
Studied group	800.930	1	800.930	31.163	.000	.563
Gender	539.481	1	539.481	20.991	.053	.105
Group	760.508	1	760.508	29.591	0.26	.004
Error	3007.068	117	25.701			
Total	245536.000	121				
Corrected Total	4929.290	120				

a. $R^2 = .583$ (Adjusted $R^2 = .551$

The analysis presented in Table 4 above indicates a lack of statistically significant differences associated with the variable pre-test and this indicates that the pupils surveyed when responded to the pre-test were not have any training using the number manipulation strategy. Therefore, subjects exposed to both experimental and control groups have the same mental ability level and educational level before they were exposed to the training and teaching with the number manipulation strategy. More so, it is observed from Table 4 that the mean of the experimental group was greater since the group scored 38.47 with an SD of 6.17, while the mean of the conventional group that was taught using the conventional approach was lower as it scored 37.76 with SD of 8.45. This indicates that the difference in the means of the two groups was in favor of the experimental group that was taught with the NUMAS, which means that the use of the NUMAS in teaching pupils arithmetic had a positive effect on the achievement of the pupils in arithmetic compared to the conventional approach. The difference in mean performance between the two groups was further subjected to statistical hypothesis 1.

The ANCOVA result of Table 4 was used to test hypothesis 1 which indicated that the covariate (i.e. the pre-test) accounted for a significant difference found in the achievement scores of the pupils taught with NUMAS and conventional approach [F = (1,120) = 0.000; $p < .05$]. The null hypothesis one of no significant difference is therefore rejected. Furthermore, it is observed from Table 4 above that the difference in the mean performance of male and female pupils exposed to the experimental treatment was further subjected to statistical hypothesis (2). The result was indicated in Table 4 which revealed that the calculated f-value for the performance of male and female pupils taught arithmetic using number manipulation strategy is 20.991 with the level of significance as 0.26 which is greater than 0.05 being the benchmark for the study. Thus, the null hypothesis of no significant difference is not rejected. This result implies that the performance of the male and female subjects exposed to the experiment is at the bar. This result clearly indicated that gender is not a significant factor of variance when NUMAS is used in arithmetic teaching and learning.

Research Question Three: What are pupils' opinions on how far NUMAS influences their interest in learning arithmetic? Research question three was answered using Table 5 below.

Table 5: Measures of Pupils' Level of Interest in Arithmetic when NUMAS is used in teaching them Arithmetic

S/N	Items Description	Method			
		NUMAS		Conventional	
		Mean	SD	Mean	SD
1	Teaching me arithmetic with NUMAS brought back my loss of interest in arithmetic learning.	3.12	0.113	2.09	2.148
2	The NUMAS has improved my performance in addition and subtraction operations.	3.88	1.028	2.34	2.401
3	I like arithmetic to be taught every day since I am taught arithmetic with NUMAS.	3.01	1.105	1.97	2.304
4	I can now handle the addition and subtraction of numbers with many digits (e.g. six, seven, eight, etc, digit numbers).	3.07	2.011	2.38	1.963
5	I have started to like my teacher because he/she teaches me arithmetic with NUMAS.	3.65	2.058	2.50	1.88
6	I am now happier learning arithmetic than any other subject because NUMAS has made it stimulating to me.	3.9	0.941	2.47	2.634
7	The phobia (fear) I have in learning arithmetic has disappeared since my teacher started using NUMAS in teaching me arithmetic.	3.01	1.613	2.23	2.151
8	I will like to study Mathematics in the future.	2.92	1.002	2.11	1.61
	Grand Mean	3.32	1.234	2.26	2.136

Table 5 above shows that primary schools pupils in Igbo-Etiti local government area are interested in arithmetic learning when NUMAS is used (mean = 3.32; SD = 1.234) rather than conventional method (with mean = 2.26; SD = 2.136). The highest mean interest score (3.9, item 6) and the least mean interest score (mean = 2.92; SD = 1.002) indicated that the interest these pupils have in arithmetic and arithmetic learning when taught with NUMAS are high enough to justify that NUMAS is effective in capturing pupils' interest in arithmetic learning. The mean interest rating of the pupils concerning the methods used in teaching them arithmetic was further subjected to hypothesis testing (hypothesis three.

Table 6: T-Test of Pupils' Opinions on their Interest in Arithmetic Teaching and Learning Based on Method

Method	N	Mean	SD	DF	$t_{cal.\ val.}$	$t_{crit.\ val}$	Decision
NUMAS (Expr. Group)	54	3.38	1.267	119	3.433	1.96	S*
Conventional (control group)	67	2.28	2.21				

*S = Significant at $p \leq .05$.

Table 6 shows that t-cal. (3.433) >$t_{crit.\ val.}$ (1.96). Hence, the null hypothesis which stated that there is no significant difference in the mean interest scores of the pupils due to the method was rejected. That means the interest of the pupils differs significantly because of the different methods used in teaching them arithmetically. That means the new strategy has brought about positive change in the interest of the pupils in learning the subject.

Research Question 4: What are the pupils' opinion on how far NUMAS influence their interest in arithmetic learning due to gender? Research question 4 was answered using Table 7 below:

Table 7: Measures of Pupils' level of Interest in Arithmetic Learning Based on Gender

S/N	Items Description	Gender			
		Male		Female	
		Mean	SD	Mean	SD
1	Teaching me arithmetic with NUMAS brought back my loss of interest in arithmetic learning	3.71	1.124	2.96	1.053
2	The NUMAS has improved my performance in addition and subtraction operations	3.86	2.531	2.80	2.648
3	I like arithmetic to be taught every day since I am taught arithmetic with NUMAS	3.48	0.948	3.51	1.333
4	I can now handle the addition and subtraction of numbers with many digits (e.g. six, seven, eight, etc, digit numbers)	3.65	1.413	2.89	2.186
5	I have started to like my teacher because he/she teaches me arithmetic with NUMAS	2.73	2.012	2.84	1.628
6	I am now happier learning arithmetic than any other subject because NUMAS has made it stimulating to me.	3.81	0.611	3.10	1.579
7	The phobia (fear) I have in learning arithmetic has disappeared since my teacher started using NUMAS in teaching arithmetic	3.28	1.265	3.31	2.001
8	I will like to study Mathematics in the future	3.01	1.033	2.61	1.449
	Grand Mean	3.44	1.234	3.00	1.735
	Mean Difference	0.44			

Table 7 above shows that grand interest scores of male and female pupils in learning arithmetic ate 3.44 with SD of 1.367 and 3.00 with an SD of 1.735 respectively with a mean difference of 0.44 in favor of males shows that male pupils are more interested in learning arithmetic than their female counterpart, especially when NUMAS is used in teaching them Mathematics. More so, the mean interest scores of both sexes are all above the 2.50 benchmark, which indicates that all the pupils agreed that the use of NUMAS enhances their interest in the subject. The mean difference observed between the two sexes was subjected to statistical analysis in hypothesis four.

Research Hypothesis Four: There is no significant difference between the mean interest rating scores of male and female pupils exposed to NUMAS on the attainment of standard in teaching and learning of arithmetic. Research hypothesis four was tested at a 5% level of significance using Table 8 below.

Table 8: T-Test of Pupils' Opinion on their Interest in Learning Arithmetic Based on Gender

Gender	N	Mean	SD	DF	$t_{cal. val.}$	$t\text{-}_{crit. val}$	Decision
Male	71	2.67	1.415	119	1.2914	1.66	NS*
Female	50	3.06	1.775				

NS* = Not Significant

Table 8 shows that the t-cal. val of 1.291 is less than the t-crit value of 1.96. Hence, the null hypothesis which stated that there is no significant difference in the mean interest scores of the pupils due to gender was accepted. That means the interest of the pupils did not differ significantly because of their gender differences.

4. Discussion of Results

Reversing the trend of poor performance in Mathematics requires enhancing teaching and learning of arithmetic among pupils at the foundational level of the education system in Nigeria through the use of manipulation-oriented approaches. Invariably, the number manipulation strategy belongs to such approaches. The researcher did not presume that he controlled all the extraneous variables strictly. Pupils in the control and experimental group could interact after school hours and share experiences with the research process as natural to their age bracket. The mean score of the control group in pre-ART was slightly higher than that of the experimental group. At the post-test, as shown in Table 2, the experimental group gained a high mean increase. The researcher noted that the experimental group scored higher in the post-test than in the pre-test. This high mean gain score of the experimental group could be attributed to the effectiveness of the experiential teaching strategy (NUMAS) used. This result supported the National Policy on Education (FRN, 2013) objectives which stated that the teaching method (strategy) used in teaching a child should ensure the child's acquisition of the appropriate levels of literacy.

Numeric and manipulative skills are required for laying a solid foundation for lifelong learning. The mean difference between the two groups was further tested for the significant mean difference which F (1,30.037, $p < .05$) indicated that there is a significant difference between the mean achievement scores of the studied control and experimental groups. This finding suggests that the number manipulation strategy is effective in teaching and learning arithmetic because it improves pupils' performance in Mathematics. This finding aligns with what demanded that the activity-based method should be used in teaching Mathematics because it makes the teaching of Mathematics practical and experiential (FRN, 2013). Research question two sought to determine the impact of NUMAS on male and female pupils' achievement in Mathematics. It was found that female pupils recorded higher mean gain scores than male pupils in the two tests (pre and post-test). ANOVA test statistic was computed to partial out the possible effect of existing cognitive ability differences.

The mean difference between males and females was tested for significance mean differences F(1,20.991, $p < .05$). The researcher concluded that the gender differences could not have emanated from manipulation of the NUMAS used in instruction. The second null hypothesis of no significant difference is therefore not rejected. This result clearly indicated that gender is not a significant factor of variance when NUMAS is used in arithmetic instruction. This finding corroborates (Unodiaku, 2018; Anaduaka, Sunday and Olaoye, 2018; Jane and Janet, 2016) who all reported no significant difference in Mathematics achievement tests between males and female students. This finding indicated that the use of NUMAS can improve pupils' performance in arithmetic, particularly in bridging the gap in Mathematics performance between male and female pupils. Research Question three revealed that the interest of the pupils differs significantly ($t=3.433$, 119; tcrit = 1.96), because of different methods used in teaching them arithmetic. The difference in mean interest rating was a result of the new strategy (NUMAS) used in arithmetic instruction, which has brought about a change in the interest of the pupils in learning the subject.

That means NUMAS is capable of bringing positive change in the interest of pupils in studying Mathematics. This result suggests that a new and effective method of teaching Mathematics should be sought for, especially at the foundational level. Research question 4 showed that gender is not a significant factor of variance ($t=1.2914$, 119; t-crit = 1.96) when a new strategy such as NUMAS is fused into measuring pupils' interest in studying Mathematics. Although the mean difference in interest rating of male and female pupils showed that males are more interested in arithmetic learning than their female counterparts, yet the mean difference was tested (t-cal. = 1.2914, 119; t-crit = 1.96) and found not statistically significant. This finding shows that NUMAS is effective in raising pupils' interest in arithmetic learning and hence can enhance their academic performance on the subject. This finding was supported by an earlier report, (Alio and Okafor, 2017) who noted that interest is an inhibiting factor to Mathematics achievement among pupils. That means any strategy such as NUMAS that can be infused into the teaching of arithmetic at the foundational level is imperative.

5. Conclusion and Recommendations

National Policy on Education guidelines target to achieve the set objectives, namely, acquisition of the appropriate levels of literacy, numeric and manipulative skills required for laying a solid foundation for life-long thinking and problem-solving of citizens in the society. The implication is that Mathematics teaching should be geared towards capturing pupils' interest in the subject as well as ensuring that pupils at the primary school level grasp manipulative skills that can enable them to perform well at higher Mathematics learning. Following the development of the new Number Manipulation Strategy (NUMAS), a strategy that can enhance pupils' manipulative skills and numeric competency and capture their interest in the subject has emerged. This new strategy is discovered can serve the 21st-century pupils of lower basic levels.

Recommendations: Based on the findings of the study, the researcher made the following recommendations:

- Teachers of pupils at the lower basic level should adopt the experiential instructional strategy for enhancing the pupils' manipulative and numeric skills in arithmetic.

- Authors of lower basic Mathematics textbooks should incorporate the NUMAS in teaching topics involving addition and subtraction of whole numbers.
- Stakeholders in education should make policies involving the use of strategies to enhance methods in arithmetic classes.
- Examination agencies such as the Ministry of Education should incorporate the NUMAS in testing pupils' ability in addition and subtraction of whole numbers.

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