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TABLE OF CONTENTS

A STUDY OF SOCIAL NETWORKING AMONG TERTIARY INSTITUTION STUDENTS: CASE STUDY OF ADEYEMI COLLEGE OF EDUCATION, ONDO, ONDO STATE, NIGERIA - **M. K. Soetan, Ademikanra Adedayo, O. & Eya Victor**..... 1-8

ABUSE OF POLITICAL PROCESSES AMONG ELITES IN NIGERIA
Samuel Olanrewaju OLADAPO..... 9-17

ATTITUDE OF STUDENTS TOWARDS VIOLENCE AND CULTISM IN SECONDARY SCHOOLS INIKPOBA-OKHA LOCAL GOVERNMENT AREA OF EDO STATE - **OSENWEUGWOR NGOZI AIHIE & CORNELIUS AMU**..... 18-25

INFLUENCE OF PARENTING ON STUDENTS EDUCATION IN SELECTED TERTIARY INSTITUTIONS IN ONDO STATE, NIGERIA
[1]Martina Bosede AJIBEFUN Ph.D & [2]Durojaye Segun AKINYOMBO Ph.D..... 26-34

CLASSROOM ENVIRONMENT AND LEARNING OUTCOMES OF CHILDREN WITH FINE MOTOR SKILL DEVELOPMENTAL COORDINATION DISORDER IN OSUN STATE, NIGERIA
M. Olugbenga OMIYEFA Ph.D&Evelyn Nwanneka SANNI..... 35-44

DEVELOPMENT AND VALIDATION OF LEARNING ACTIVITIES FOR TEACHING MOTION IN PHYSICS, IBADAN, OYO-STATE, NIGERIA
Edidiong Enyeneokpon UKOH. Ph. D & Peter Obaloluwa OMOTOSO..... 45-53

A STUDY ON THE EXTENT OF ICT RESOURCES UTILIZATION IN LEARNING SENIOR SECONDARY SCHOOLS PHYSICS IN ILE-IFE, OSUN STATE, NIGERIA - **Olusegun Ojo BAKARE (Ph.D)**..... 54-63

IMPACT OF INDIVIDUAL METHOD IN USING ARTS AND CRAFT A THERAPEUTIC INTERVENTION FOR SELECTED HANDICAPPED STUDENTS IN FEDERAL COLLEGE OF EDUCATION (SPECIAL), OYO, OYO STATE, NIGERIA - **OLANIYI DAVID BABATUNDE**..... 64-74

EFFECTS OF NUMBERED-HEADS-TOGETHER AND HEURISTIC METHODS ON THE PUPILS' ACADEMIC PERFORMANCE IN SOCIAL STUDIES IN ILORIN EAST LOCAL GOVERNMENT AREA OF KWARA STATE, NIGERIA - **Yahaya OLAREWAJU, Olumuyiwa Ajayi & Usman Tunde SAADU**..... 75-82

EFFECT OF MNEMONICS STRATEGY ON PUPILS' ACADEMIC PERFORMANCE IN LITERACY IN ILORIN WEST LOCAL GOVERNMENT AREA, KWARA STATE, NIGERIA - **Olumuyiwa Ayobami AJAYI, Ph.D; Usman Tunde SAADU Ph.D & Omilola Amina OLAWOLE.....** 83-91

PRESCHOOL TEACHERS ATTITUDE TOWARDS SLOW LEARNERS IN POST COVID-19 ERA IN ILORIN EAST LOCAL GOVERNMENT AREA OF KWARA STATE, NIGERIA - **Yahaya OLAREWAJU; Bilikis Ajoke OLASINDE & Halimat I'ya ISMAIL-ORIRE.....** 92-106

NIGERIA'S SOCIAL POLICIES AND DEVELOPMENTAL STRATEGIES: QUESTIONING MAL-ADMINISTRATION AND GOVERNMENTAL INSINCERITY OF PURPOSE - **BOLAJI, Ibrahim Akanbi, ZUBAIR, Ganiyu Adebayo, AFOLAYAN, Simeon Olanrewaju & SALAMI, Ganiyu Omotayo.....** 107-114

TEXTBOOK UTILIZATION AS PREDICTOR OF ACADEMIC ACHIEVEMENT IN BASIC SCIENCE AND TECHNOLOGY IN LOWER PRIMARY SCHOOLS IN SOUTHWESTERN, NIGERIA
Abe, Josephine Oluremi &Agboola, Omowunmi Sola..... 115-126

EFFECT OF CONCRETE-REPRESENTATIONAL-ABSTRACT ON PUPILS' ACADEMIC PERFORMANCE IN NUMERACY IN MORO LOCAL GOVERNMENT AREA, KWARA STATE, NIGERIA - **Lukman Ajanaku HAMMED, Olumuyiwa Ayobami AJAYI (Ph.D.) & Kayode Ezecheal OBAFEMI .....** 127-136

TEST ANXIETY, AGE AND GENDER AS PREDICTOR OF SCIENCE UNDERGRADUATE STUDENTS' ATTITUDE TOWARDS EXAMINATION MALPRACTICE IN OBAFEMI AWOLOWO UNIVERSITY, ILE-IFE, NIGERIA
OLAJIDE Simeon Olayinka, (Ph.D), ANIMOLA Odunayo Victor, (Ph.D) & AKINLOSOSE Boluwaji Emmanuel..... 137-144

EFFECTS OF SMALL GROUP DISCUSSION METHOD ON PUPILS' ACADEMIC PERFORMANCE IN NUMERACY IN BARUTEN LOCAL GOVERNMENT AREA OF KWARA STATE, NIGERIA
Usman Tunde SAADU Ph.D & Tinuade Adekemi ADEDOKUN..... 140-149

EFFECT OF THINKING MAPS ON PUPILS' ACADEMIC PERFORMANCE IN BASIC SCIENCE IN ILORIN SOUTH LOCAL GOVERNMENT, KWARA STATE - **Olumuyiwa Ayobami AJAYI, Ph.D & Mary Oladamola ADEBOYE.....** 145-152

CLASSROOM ASSESSMENT: ASSESSMENT FOR LEARNING, ASSESSMENT OF LEARNING AND ASSESSMENT AS LEARNING
Imasuen Kennedy & IYAMU Ikpomwen Florence..... 153-160

STUDENTS' ATTITUDE AS A DETERMINANT OF BASIC GENERAL MATHEMATICS PERFORMANCE IN FEDERAL COLLEGES OF EDUCATION SOUTHWEST, NIGERIA
Oluwafunmike Oyenike EZEKIEL, Prof. Philias Olatunde YARA & Olubiyi Johnson EZEKIEL..... 161-169

SECOND-CLASS EDUCATION FOR SECOND-CLASS CITIZENS? AN ASSESSMENT OF SCHOOL INFRASTRUCTURE IN URBAN AND RURAL PUBLIC SECONDARY SCHOOLS IN NIGERIA
Grace Oluremilekun AKANBI, Ph.D..... 170-181

3. Government being major stakeholders in education should ensure the provision of learning facilities that could make the learning environment conducive in school,
4. Teachers should be motivated and updated on how to make teaching-learning interesting irrespective of the subject matter.
5. Education remains the bedrock of development in any country, government should make the achievement of standard education her priority.

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EFFECT OF CONCRETE-REPRESENTATIONAL-ABSTRACT ON PUPILS' ACADEMIC PERFORMANCE IN NUMERACY IN MORO LOCAL GOVERNMENT AREA, KWARA STATE, NIGERIA

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Abstract

*The study examined the effects of concrete-representational-abstract on pupils' academic performance in numeracy in Moro Local Government Area, Kwara State. The researcher adopted pre-test, post-test, non-equivalent control group quasi-experimental research design. The population comprised all primary school pupils in Moro Local Government. Three public and three private primary three classes were sampled. Three instruments were used for this study. Instructional Guide on Concrete-representational-abstract (IGCRA)**,** Instructional Guide on Conventional Teaching Method (IGCTM) and Test on pupils' Numeracy Academic Performance (TPNAP). Seven research hypotheses were formulated and tested at 0.05 level of significance. Data were analysed using the Analysis of Co-Variance (ANCOVA). The findings of the study revealed that there was significant main effect of treatment on pupils' academic performance in numeracy ($F_{(1; 64)} = 76.186; P < 0.05$). There was no significant main effect of gender on pupils' academic performance ($F_{(1; 64)} = 0.001; P > 0.05$There was no significant main effect of school type on pupils' academic performance in numeracy ($F_{(1; 64)} = .651; P > 0.05$).There was no significant interaction effect of treatment and gender on pupils' numeracy academic performance ($F_{(1; 64)} = .245; P > 0.05$). There was no significant interaction effect of treatment and school type on pupils' numeracy academic performance ($F_{(1; 64)} = .856; P > 0.05$).There was no significant interaction effect of gender and school type on pupils' numeracy academic performance ($F_{(1; 64)} = 1.225; P > 0.05$). There was no significant interaction effect of treatment, gender and school type on pupils' numeracy academic performance ($F_{(1; 64)} = .796; P > 0.05$). The study concluded that concrete-representational-abstract could be adopted for teaching Numeracy to improve academic performance at the primary school level. Based on the findings of the study, was recommend that adoption of this strategy should be made for teaching numeracy*

Key words: Concrete-Representational-Abstract,Academic Performance

Introduction

The goals and objectives of teaching and learning in a classroom is to bring about a desirable change in learners which could be in terms of knowledge and behaviour. This change is possibly determined through the extent of the pupils' performance on learning activities. Based on personal experience, the selection of teaching and learning method will determine the effectiveness of the academic performances of pupils in numeracy. However, there is the need to verify the appropriateness of selected approach by the teacher before lesson. Numeracy is the basis for Science and Technology as well as a tool for achieving

scientific and technological development. Numeracy is one of the elements of education. Akinoso (2013) opined that Numeracy is a field of Science which is a means of thinking and communicating; a tool to solve various practical problems, whose elements are logic and intuition, analysis and construction, generality and individuality, while it has branches such as arithmetic, algebra, geometry, and analysis. Supandi, Waluya, Suyitno and Dewi (2018) stated that Pupils who are able to represent mathematical idea correctly have a good understanding of the mathematical concept. Thus, numeracy can be represented through the use of visual objects, for instance, charts, diagrams, tables, and sketches/drawings and non-visually for instance mathematical equations and models. Purwadi, Sudiarta & Suparta (2019) viewed that Presentation of fractions in a simple form makes it easier for pupils to understand teaching and learning and problem-solving and innovation, location, gender and technology influence academic performance of pupils in numeracy

Poor pupils' numeracy academic performance was also evident in one of Adeyemi's (2011) submission. While comparing students' academic performance in public examinations in Osun and Ekiti States of Nigeria, Adeyemi found low pupil academic performance in numeracy and integrated science during the years under review.

Pupils' academic performance may be improved through the use of Concrete, Representational and Abstract (CRA). Concrete, Representational and Abstract (CRA) is a sequential instructional approach during which students move from working with concrete materials to creating representational drawings to using abstract symbols (National Mathematical Advisory Panel, 2008). Using this CRA sequence helps the pupils to develop thorough mental representations that are foundational for conceptual understanding. The *CRA has* three parts of instructional strategy that builds pupils' conceptual understanding by explicitly teaching meaningful connections from hands on manipulatives, to representational pictures, to abstract concepts and symbols. (National Mathematical Advisory Panel, 2008).

The initial instructional stage of CRA is the “doing” stage where pupils learn to use hand-on manipulatives to practice numeracy concepts. This stage includes visual, tactile and kinesthetic modalities (Witzel, Riccomini, & Schneider, 2008). The second stage in CRA: the “seeing” stage where pupils learn and practice numeracy using pictures to represents objects to model the concepts (Access Center, 2004). The final instructional stage in CRA is the “symbolic” stage, where pupils learn to use numbers and abstract symbols to model numeracy concepts (Access Center, 2004).

Concrete-Representational-Abstract Instructional Strategy may enhance pupils' achievement in numeracy where teaching move gradually from concrete to representational then abstract level. Witzel (2005) opined that CRA as a three-staged learning process where pupils learn through physical manipulation of concrete objects in the first stage, followed by learning through pictorial representations of the concrete manipulations in the second stage and ending with solving problems using abstract notation, numbers and symbols in the third stage. According to Haley (2016), CRA instructional strategy stresses the importance of beginning the instruction of new mathematical concepts with concrete lessons before moving to abstract representations. The CRA method of instruction can help pupils build a deep conceptual understanding of subtraction concepts involving regrouping, provided they are given clear demonstrations and models as well as enable them have extensive practice opportunities for newly learned skills (Mancl, Miller & Kennedy, 2012). The academic performance of children can be improved when they learn through the use of concrete and manipulative method.

Bronfenbrenner (2005) stated that gender possesses some characteristics which allow the researcher to be able to get accurate result. It is a variable to be considered in any research work in order to get a meaningful result. Gender differs and varies within and across cultures overtime; results in different roles; responsibilities, opportunities, needs and constraints for women, men, boys and girls. Kamla-Raj (2009), in his study of pupils performance in Junior Secondary in mathematics, found out that pupils' poor performance in numeracy in Junior Secondary School examination was high: male pupils performed better than female; pupils from rural schools performed better than pupils from urban schools in numeracy; and pupils from private schools performed better than pupils from public schools. Oginni (2009) asserted that male pupils performed better than their female counterparts in numeracy laboratory lessons.

Musa and Hartley (2015) reported a significant relationship between thrichotomous achievement goals and academic performance of pupils in English and overall academic performance in Borno State. The males performed significantly better than females in English Language and overall academic performance but there is no gender difference in numeracy performance. Furthermore, there is significant effect of gender on pupils' learning goal orientation in favour of males, whereas there are no gender effects on performance approach and performance-avoidance goals orientation of pupils (Musa, Dauda & Umar, 2016).

Gender differences in numeracy performance began to appear at the upper primary school level and increase in secondary schools. These differences are caused by reciprocal-action of many factors within and outside the school as well as by the pupils' background. Many studies showed gender performance numeracy, with females performing significantly worse than males. However, such views were not unanimously shared with other research demonstrating no differences (Lindberg, Hyde, Linn & Petersen, 2010; Scafidi & Bui, 2010). Studies also portrayed that gender has a significant effect on maths-based, affective variables that predict numeracy, particularly anxiety and confidence, with females demonstrating much stronger negative effect compared to males (Durrani & Tariq, 2009; Kargar, Tarmizi & Bayat, 2010).

School type should not be overemphasized, as the name implies, Public and private schools are institutions owned by government and private. The public schools in Nigeria own by the Federal, State, and Local Governments as their proprietors while the private schools are owned by individuals, associations or private organizations. Berkeley Parent Network (2009) asserted that private schools vary widely and level of parental involvement varies from one private school to the other. Parents pay for the cost of educating their children in private schools, thus, they tend to be more involved in dictating what the schools offer than parents whose children are attending public schools (Olatoye & Agbatogun, 2009). There was a significant difference in numeracy and science achievement of public and private school pupils in which private school pupils performed better than public school counterparts in numeracy and science in public and private schools (Olatoye & Agbatogun, 2009).

There was significant difference in mathematics and science achievement of public and private school pupils in which private school pupils performed better than public school counterparts in mathematics and science. The discussions so far show that there is a need to compare private and public school student's performance in science (Olatoye & Agbatogun 2009). Therefore, this study examined whether the teaching through the use of concrete representational abstract explicitly enhance pupils' academic performance in numeracy

taking gender and school-type into consideration.

Statement of the Problem

Numeracy plays a significant role in this modern age of science and technology which enables us to understand how to solve real life problem on daily basis, yet, pupils are not performing well in the subject. Studies have shown that pupils have poor academic performance in numeracy. During the researcher's teaching practice in the year 2016, most pupils found it difficult to answer some of the numeracy questions. A Report from Kwara State Ministry of Education showed that more than 60 percent of pupils who took the Junior Secondary School Common Entrance Examination in the year 2020 scored less than 50 percent. It shows that pupils have negative attitude towards learning numeracy which could be as a result of principle and practice being used by numeracy teachers. The poor academic performance of pupils in numeracy at this level is a source of concern to all educational stakeholders since its one of the major subjects at the primary school level. More so, it is the bedrock of technological advancement of any nation.

Based on the level of performance of pupils in numeracy in Nigeria, precisely in Moro Local Government Area, it is clear that pupils have low grade in numeracy. This could be as a result of the teaching strategy being used by numeracy teachers. Concrete-representational-abstract involves sequential instructional approach which depicts how pupils work with concrete materials, create representational drawings, to use abstract symbols. This processes may help pupils to be actively involved in classroom activities. However, to the best of researcher's knowledge teaching of numeracy has not explore these strategies in Kwara State, specifically in Moro Local Government primary schools. Based on the above, the researcher intends to find out the effect of concrete representational abstract (CRA) on primary school pupils' academic performance.

Purpose of the Study

The main purpose of this study was to determine the main effect of concrete representational abstract on pupils' academic performance in numeracy in Moro Local Government Area of Kwara State.

The specific objectives of the study are to:

1. examine the main effect of gender on pupils' academic performance in numeracy in Moro Local Government Area of Kwara State.
2. investigate the main effect of school-type on pupils' academic performance in numeracy in Moro Local Government Area of Kwara State.
3. assess interaction effects of treatment and gender on pupils' numeracy academic performance in Moro Local Government Area of Kwara State.
4. determine the interaction effect of treatment and school-type on pupils' numeracy academic performance in Moro Local Government Area of Kwara State.
5. examine interaction effect of gender and school-type on pupils' numeracy academic performance in Moro Local Government Area of Kwara State.
6. determine the interaction effect of treatment, gender and school-type on pupils' numeracy academic performance in Moro Local Government Area of Kwara State.

Hypotheses

The following null hypotheses were formulated and tested at 0.05 level of significance for the study.

H_o1: There is no significant main effect of treatment on pupils' academic performance in numeracy in Moro Local Government Area of Kwara Stat

H_o2: There is no significant main effect of gender on pupils' academic performance in numeracy in Moro Local Government Area of Kwara State.

H_o3: There is no significant main effect of school-type on pupils' academic performance in numeracy in Moro Local Government Area of Kwara State.

H_o4: There is no significant interaction effect of treatment and gender on pupils' numeracy academic performance in Moro Local Government Area of Kwara State.

H_o5: There is no significant interaction effect of treatment and school-type on pupils' numeracy academic performance in Moro Local Government Area of Kwara State.

H_o6: There is no significant interaction effect of gender and school-type on pupils' numeracy academic performance in Moro Local Government Area of Kwara State.

H_o7: There is no significant interaction effect of treatment, gender and school-type on pupils' numeracy academic performance in Moro Local Government Area of Kwara State.

Methodology

The study adopted pre-test, post-test, nonequivalent control group quasi-experimental research design. A factorial design of 2X2X2 was adopted. The population for this study comprised all primary three pupils (three private and three public schools) in Moro Local Government Area of Kwara State.

Simple random sampling was used to select four primary schools. Stratified sampling technique was used to select two public schools and two private schools. Purposive sampling technique was used to select schools that have both genders. Classes were assigned to two experimental groups and two control groups. Intact classes were used to avoid disruption of classes. Sample size comprised 73 primary school pupils. Instructional Guide on Concrete-representational-abstract (IGCRA), Instructional Guide on Conventional (Traditional) Teaching Method (IGCTM) and Test on pupils' Numeracy Academic Performance (TPNAP) were used to elicit information from respondents. Instruments were validated by three lecturers in the department of Early childhood and primary Education and the reliably tested at 0.75. Data were analysed using frequency, percentage and Analysis of Co-variance (ANCOVA) at 0.05 level of significance. The ANCOVA considered appropriate because of pretest and posttest.

Results

Hypothesis One: There is no significant main effect of treatment on pupils' academic performance in Numeracy in Moro Local Government Area of Kwara State, Nigeria

Table 1: Summary of Analysis of Covariance showing the Main Effects of Treatment on

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	418.965a	4	52.371	20.718	.000
Intercept	470.317	1	470.317	186.063	.000
Pretest	5.486	1	5.486	2.170	.146

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Treatment	192.578	1	192.578	76.186	.000
Gender	.002	1	.002	.001	.976
School type	1.645	1	1.645	.651	.423
Treatment * Gender	.620	1	.060	.245	.622
Treatment * School type	2.163	1	2.163	.856	.358
Gender * School type	3.096	1	3.096	1.225	.273
Treatment * Gender * School type	2.013	1	2.013	.796	.375
Error	161.775	69	2.528		
Total	16235.000	74			
Corrected Total	580.740	73			

Table 1 shows the main effect of treatment on pupils' academic performance in Numeracy. There was significant main effect of treatment on pupils' academic performance in Numeracy ($F(1; 64) = 76.186$; $P < 0.05$). The hypothesis is therefore rejected in the light of the result since the significant value (.000) is less than 0.05. This implies that treatment had significant effect on pupils' academic performance in Numeracy. Table 2 revealed the sources of the difference in pupils' academic performance in Numeracy.

Table 2: Summary of Bonferroni's Post Hoc pairwise Comparison of the scores within the three Groups

Treatment	Mean Score	Experiment 1	Control Group
Concrete Representation Abstract Strategy	16.05	*	
Conventional Method	10.39		*

Table 2 revealed that the significant main effect exposed by table 1 is as a result of the significant difference between:

i. Concrete Representational Abstract Strategy
ii. Conventional method

This implies that those exposed to Concrete Representational Abstract Strategy (Mean = 16.05) performed significantly better than those exposed to conventional method (Mean = 10.39).

Hypothesis Two: There is no significant main effect of gender on pupils' academic performance in numeracy in Moro Local Government Area of Kwara State.
Table 1 also revealed the main effect of gender on pupils' academic performance in numeracy. There was no significant main effect of gender on pupils' academic performance in numeracy ($F_{(1; 64)} = .001$; $P > 0.05$). The hypothesis is therefore not rejected in the light of the result since the significant value (.976) is greater than 0.05. This implies that gender had no significant effect on pupils' academic performance in numeracy.

Hypothesis Three: There is no significant main effect of school type on pupils' academic performance in numeracy in Moro Local Government Area of Kwara State.
Table 1 also revealed the main effect of school type on pupils' academic performance in

numeracy in Moro Local Government Area of Kwara State. There was no significant main effect of school type on pupils' academic performance in numeracy ($F_{(1; 64)} = .651$; $P > 0.05$). The hypothesis is therefore not rejected in the light of the result since the significant value (.423) is greater than 0.05. This implies that school type had no significant effect on pupils' academic performance in numeracy.

Hypothesis Four: There is no significant interaction effect of treatment and gender on pupils' numeracy academic performance in Moro Local Government Area of Kwara State.
Table 1 also revealed the interaction effect of treatment and gender on pupils' numeracy academic performance in Moro Local Government Area of Kwara State. There was no significant interaction effect of treatment and gender on pupils' numeracy ($F_{(1; 64)} = .245$; $P > 0.05$). The hypothesis is therefore not rejected in the light of the result since the significant value (.622) is greater than 0.05. This implies that the interaction of treatment and gender had no significant effect on pupils' numeracy academic performance.

Hypothesis Five: There is no significant interaction effect of treatment and school type on pupils' numeracy academic performance in Moro Local Government Area of Kwara State.
Table 1 also revealed the interaction effect of treatment and school type on pupils' numeracy academic performance in Moro Local Government Area of Kwara State. There was no significant interaction effect of treatment and school type on pupils' numeracy academic performance in Moro Local Government Area of Kwara State ($F_{(1; 64)} = .856$; $P > 0.05$). The hypothesis is therefore not rejected in the light of the result since the significant value (.358) is greater than 0.05. This implies that the interaction of treatment and school type had no significant effect on pupils' numeracy academic performance in Moro Local Government Area of Kwara State.

Hypothesis Six: There is no significant interaction effect of gender and school type on pupils' numeracy academic performance in Moro Local Government Area of Kwara State.
Table 1 also revealed the interaction effect of gender and school type on pupils' numeracy academic performance in Moro Local Government Area of Kwara State. There was no significant interaction effect of gender and school type on pupils' numeracy academic performance in Moro Local Government Area of Kwara State ($F_{(1; 64)} = 1.225$; $P > 0.05$). The hypothesis is therefore not rejected in the light of the result since the significant value (.273) is greater than 0.05. This implies that the interaction of gender and school type had no significant effect on pupils' numeracy academic performance.

Hypothesis Seven: There is no significant interaction effect of treatment, gender and school type on pupils' numeracy academic performance in Moro Local Government Area of Kwara State.
Table 1 also revealed the interaction effect of treatment, gender and school type on pupils' numeracy academic performance in Moro Local Government Area of Kwara State. There was no significant interaction effect of treatment, gender and school type on pupils' numeracy academic performance in Moro Local Government Area of Kwara State ($F_{(1; 64)} = .796$; $P > 0.05$). The hypothesis is therefore not rejected in the light of the result since the significant value (.375) is greater than 0.05. This implies that the interaction of treatment, gender and school-type had no significant effect on pupils' numeracy academic performance.

Discussion of Findings

A finding of this study revealed that there was significant main effect of treatment on the academic performance of primary school pupils in numeracy in Moro Local Government Area of Kwara State. This might be as a result of pupils' exposure to the concrete objects in the location of the study. This is in line with the finding of Nneka, (2019) who revealed that concrete-representational-abstract strategy had significant effect on the mean achievement scores of pupils with dyscalculia in numeracy. It is show that concrete-representational-abstract are effective for teaching numeracy in Moro Local Government Area of Kwara State. This finding negates that of Bangis and Gaylo (2019) who revealed that treatment before Grade six, learners were taught using concrete representational abstract approach and their academic performance was low. However, after they were taught using concrete-representational-abstract approach, they reached fairly satisfactory level.

Another finding further revealed that there was no significant main effect of gender on pupils' academic performance in numeracy in Moro Local Government Area of Kwara State. This finding corroborates the finding of Peteros, Gamboa, Etcuban, Dinauanao, Sitoy, & Arcadio (2020) which revealed that pupils had a moderate level of self-concept towards learning Mathematics. No gender difference was found on the self-concept of the respondents. This finding negate the result of Maliki, Ngban, and Ibu (2017) who revealed that the male pupils had the highest performance in numeracy in Junior Secondary School examinations in Bayelsa, Nigeria.

In another finding, the result also revealed that there was no significant main effect of school-type on pupils' academic performance in numeracy in Moro Local Government Area of Kwara State. The result is the same as Salman (2021) who found that there was no significant effect of school-type on academic performance of primary school pupils. The result differs from that of Mijinyawa, Yeldu, Umar & Hussaini (2017) who found that there was significant difference between public and private secondary school students' performance in all the three science subjects studied. Private schools students performed significantly better than their public school students' counterparts.

Furthermore, the finding revealed that there was no significant interaction effects of treatments and gender on pupils' numeracy academic performance in Moro Local Government Area of Kwara State. The result is not the same as the result of Nneka**,** (2019) who revealed that there was significant main effect of treatments on the mean achievement scores of pupils with dyscalculia in numeracy and there was significant influence of gender on the numeracy achievement scores of pupils with dyscalculia. The result is in line with that of Abdulkareem (2021) who found that there was no significant effect of treatment and gender on pupils' academic performance.

Another null hypothesis revealed that there was no significant interaction effect of treatment and school-type on pupils' numeracy academic performance in Moro Local Government Area of Kwara State. The result negates the finding of Igbinedion & Epumepu (2011), who both revealed that there was significant difference in the academic performance in business studies between the public and private schools from 2008 to 2011. The percentage performance trend of public schools was higher than those of the private schools among both males and females. The finding is line with the finding of Oni (2020) which revealed that there was no significant effects of treatments and school-type on reading comprehension.

In another finding, there was no significant interaction effects of gender and school-type on pupils' numeracy academic performance in Moro Local Government Area of Kwara State. This finding corroborates that of Obafemi (2017) who found that gender and school-

type did not have significant effect on pupils' academic performance in social studies. The finding negates that of Aunio, Mononen, Ragpot, & Törmänen (2016) the result revealed that there were statistically significant differences in early numeracy skills between the children when they started first grade. The differences were related to the home language of the first graders in the English medium schools, as well as the type of school (public vs. private).

There was no significant interaction effect of treatment, gender and school-type on pupils' numeracy academic performance in Moro Local Government Area of Kwara State. The finding corroborates that of Saadu, Obafemi & Yusuf (2020) who found no significant effect of gender and school type. The finding negates the finding of Mburu (2013) who found that the type of school attended affected students' academic performance as majority of the girls who qualified to join tertiary institution were from single-sex schools.

Conclusion

Conclusion was drawn based on the findings of the study. It was concluded that concrete- representational-abstract was effective for teaching numeracy in Moro Local Government Area of Kwara State. This implies that these strategy should be adopted for teaching Numeracy to improve academic performance at the primary school level.

Recommendations

Based on the findings of the study, the following recommendations were made:

1. Since concrete-representational-abstract strategy was effective for teaching numeracy, primary school teachers and administrators in both public and private schools should adopt utilization of concrete-representational-abstract due to its effectiveness.
2. The teachers should enhance their professional development or skills through such as seminars, workshop, conferences, technological training on utilization of concrete –representational-abstract strategy as well as newly discovered teaching methods/strategies.
3. The teachers should make sure that there will be no gender discriminations in schools in order to motivate all pupils during teaching and learning process.
4. The school authorities should provide age appropriate learning environment to enhance appropriate teaching strategy for numeracy.
5. The Government should provide adequate fund and equipment/materials to public and private schools so as to encourage utilization of concrete-representational- abstract strategy to improve teaching and learning process.
6. Parent-Teacher Associations, Non-Governmental Organizations and Volunteers should provide self-directed and corrected concrete material or objects to the schools and school administrators in order to encourage teachers or childhood educators to utilize them accordingly.
7. Policy makers and curriculum planners should budget enough fund to the education sector for teachers motivation.

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