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STATISTICAL ANALYSIS OF TEACHING MATHEMATICS WITH AND WITHOUT USE OF ADVANCE ORGANIZERS IN THE MAIDUGURI EDUCATIONAL ZONE OF BORNO STATE

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Abstract: *The study explores on the Statistical analysis of teaching mathematics with and without use of advance organizers in Maiduguri educational zone of Borno state with five guided objectives and five formulated hypotheses. The quasi experimental design was used. The target population of* ***65,628*** *students from 28 secondary schools within zonal education was used. Six schools were selected as sampled with six intact classes (3 as experimental groups while the other 3 as control groups). Two instruments for data collection, Mathematics Performance Test (MPT) and Mathematics Interest Questionnaire (MIQ) were used. Both were validated, pilot tested and the reliabilities calculated using PPMC to obtained 0.89 and 0.91 respectively. The data collected through administering the MP-test and MI-questionnaire to the two groups (experimental and control) before and after the treatment. The data collected were analyzed using the Z-test and U-test at alpha (α) = 0.05 level of significance. The result revealed that, there was significant difference in students' performance and interest in mathematics, the practical significant highlighting the impact of teaching mathematics with advance organizer and there is no significant difference in level of interest between male and female of the experimental groups. The study has significantly contributed and highlights the potential efficacy of Advance Organizer in enhancing students' understanding of Mathematical concepts and recommends that, the mathematics teachers should frequently use the Advance Organizers in teaching Mathematical concepts.*
Keywords: *Education. Teacher, Statistics, Mathematics, Schools*

INTRODUCTION

Education remains the largest industry in nation development and government must continue to ensure that the sector is been handled properly. The primary purpose of teaching at any level of education is to bring a fundamental transformation in the learners by applying appropriate teaching methods that best suit the objectives and learning outcomes. In the traditional era, many teachers use teacher-centered method to impart knowledge instead of student-centered method (Oyeniyi, 2019). According to Elvis (2020) how to learn is equally important with what to learn, but how to teach is more important than what to teach, because, teaching make a difference due to the method of teaching adopted. Thus, this research focused on use of Advance Organizers in teaching mathematics.

The use of Advance Organizer to ensures effective teaching as well as learning in education was advocated by Ausubel (1960) in his advance organizer learning theory known as Sub-sumption

model theory, which allows the learner to recall and transfer prior knowledge to the new information being presented. Mahdi *ed al,* (2020) in Mayor's (2003) cited that, an advance organizer helps to organize new material by outlining, arranging and sequencing the main idea of the new material based on what the learner already knows and this process helps to insert the new information into long term memory. There are two broad categories of advance organizers. 1) Expository organizers which are used whenever the new material is totally unfamiliar. 2) Comparative organizers which are used when the material to be learnt is not entirely new. Many researchers had tested the advance organizers in the classroom with different subjects at all levels. In view of the foregoing, it becomes imperative that teachers should adopt the instructional approaches in order to keep up to advancement of 21centuary in classroom for the benefit learners. Therefore, there are varieties of such approaches to be used in imparting knowledge and one of which is the use of advance organizers.

In a research conducted by Nyabwa, and Githuaj (2022) on the effects of advance organiser strategy on secondary school students' mathematics achievement in Kenya's Nakuru District and sought to examine how the use of advance organisers boost learning of mathematics indicated that, students taught using advance organisers had significantly higher scores in MAT than those taught in the conventional way and gender did not affect achievement. In a similar research conducted by Bukar, *et al.* (2021) on the impact of video advance organizers on NCE students' interest and retention in geomorphology concepts in Yobe State, Nigeria revealed that, there were higher significant difference in interest, performance and retention of students exposed to video advance organizer strategy in geomorphology concepts and there is no gender difference after treatment in any. Moreover, in a research conducted by Abubakar in (2016) on the effect of advance organizers on students' retention and performance in conservation concepts among secondary school biology in Jigawa State, Nigeria, also revealed in the major findings that, there were significant difference between the mean of academic performance and retention scores of students taught conservation concepts with advanced organizers and those taught without advance organizers in favour of the former. But there was no significant difference between the mean of academic performance and retention scores of male and female students taught conservation concepts with advanced organizers. But this study aimed to test the influence of advance organizers in mathematics.

Therefore, mathematics has been a primary requirement of schools education system throughout the world, because, it plays a vital role in understanding of various concepts of sciences and science related subjects. Mathematics is the backbone of reasoning and language of reason and service (Karjanto, 2022). It is universal truth that, learners show interest in learning subject when the methodology of teaching it deals with ground-breaking ideas, thus, the effective teaching methodology of mathematics can be fruitful to its learners (Umoetuk, 2020).

Statement of the Problem

Today the educational outcomes in mathematics seem to have a numerous setbacks due to so many reasons, but poor academic performance and retention towards subjects is one of the major contributors and attributed to teaching strategies used by teachers during instruction.

Despite the efforts being made towards ensuring that citizens of the country (Nigeria) have equal educational opportunities in order to improve their understanding and performance in both internal and external examinations, it has been observed that, all is not well with the system as a result of the poor students' performance recorded in public examinations of WAEC in the recent years, has been and continues to be miserable, particularly in mathematics results of WAEC, 2020 to 2023. Despite the efforts being made by the FME and SME and other relevant agencies embarked on capacity building workshops and seminars aimed at training and retraining of teachers for more

efficient results, students have continued to perform poorly in external examinations. Many questions has been advanced on the problem, why the poor performance, what caused it and how can it be tackled? Therefore, to address the gap, the researcher advocates and aimed to instigate on the use of advanced-organizers in teaching mathematical concepts to curtail the problems earlier stated.

Objectives of the Study

The main objective is to explore the influence of advance organizers strategy in teaching mathematics and specific objectives are to:

1. Investigate the performance of students taught mathematics with the use of advance organizer and those taught without the use of advance organizers.
2. Determine the interest level of students taught mathematics with the use of advance organizer and those taught without the use of advance organizers.
3. Investigate the retention ability of students taught mathematics with the use of advance organizer and those taught without the use of advance organizers.
4. Compare the academic performance between male and female students taught mathematics with the use of advance organizer only.
5. Compare the level of interest between male and female students taught mathematics with the use of advance organizer only.

Null Hypotheses

To further guide the objectives, the following null hypotheses were formulated to be tested at $\alpha = 0.05$ level of significance:

H_{01}: There is no significant difference between the mean scores of students' performance taught mathematics with the use of advance organizer and those taught mathematics without the use of advance organizer?

H_{02}: There is no significant difference in students' level of interest between those taught mathematics with the use of advance organizer and those taught mathematics without the use of advance organizer?

H_{03}: There is no significant difference between mean scores of students' retention taught mathematics with the use of advance organizer and those taught mathematics without the use of advance organizer?

H_{04}: There is no significant difference in the mean scores of academic performance between male and female students taught mathematics with the use of advance organizer only?

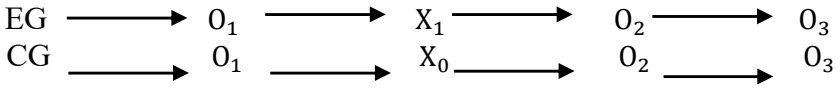
H_{05}: There is no significant difference in the scores of interest between male and female students taught mathematics with the use of advance organizer only?

METHODS

Research Design

The research design used was Quasi-Experimental, involving pre-test, Post-test and post-posttest, with experimental and control groups. Pretest was administered to determine the equivalence in terms of academic performance and interest, the pretest was administered to determine the difference in the performance and interest and post-post-test was administered to determine the level of students' retention. The Experimental Group (EG) were taught mathematics with the used of advance organizer (X_1) while the Control Group (CG) were taught the using conventional method (Xo) both for six (6) weeks.

The design is illustrated in Figure below;



Keys:

E_G = Experimental Group
C_G = Control Group
O_1 = Pre − Test
X_0 = Nomarl (conventional teaching Method)
X_1 = Treatment (using advanc organiser)
O_2 = Post − Test
O_3 = Post − Posttest

Population and Sample

The Borno State has capacity of 27 Local Government Areas with four (4) zonal education and eighty two (82) Senior Secondary Schools (SSS) distributed across the LGAs in state in the year 2023/2024 academic session. The target study area is Central part of the state that has only one educational zone called Maiduguri zonal education formed by 7 LGAs with 34 Secondary Schools, among the seven LGA, Maiduguri and Jere were selected for the study. The two LGAs (Maiduguri and Jere) had 28 secondary schools with the total population of **65,628** students, **30,628** male and **35,000** female. The study sampled six schools using random sampling method, with six intact classes, the three classes were assigned as experimental groups and taught mathematics with the used of advance organiser strategy while the other three classes as control groups were taught using the conventional teaching method, and both groups were taught for eight weeks.

Table 1: Sampled of the Six Schools with numbers of Mathematics Students

S/N	NAME OF SCHOOLS	GROUP	MALE	FEMALE	TOTAL
1	SCHOOL A	EXPERIMENTAL	35	45	80
2	SCHOOL B	CONTROL	32	43	75
3	SCHOOL C	EXPERIMENTAL	40	45	85
4	SCHOOL D	CONTROL	35	37	72
5	SCHOOL E	EXPERIMENTAL	39	44	83
6	SCHOOL F	CONTROL	37	40	77
		Total	**218**	**254**	**472**

Sources: Borno State Ministry of Education, 2024.

Instrumentation

The instruments used for the purpose of data collection were two; Mathematics Performance Test (MPT) and Mathematics Interest Questionnaire (MIQ). The MPT has 20-items multiple choice objective questions developed by the researcher from the syllabus of mathematics using table of specification adapted from Bloom (1970). The instrument contains two sections (A and B); Section A required information on the personal data while Section B presents the 20 questions with the options (A-D), listed against each question.

Table 2: Table of Specification for MPT based on Bloom's Taxonomy

Content	Know. (17.5%)	Comp. (17.5%)	Appl. (25%)	Anal. (15%)	Synth (%2.5)	Eval. (22.5)	Total (100%)
Algebra	1	1	0	0	1	1	4
Trigonometry	1	1	1	1	0	1	5
Geometry	1	1	0	0	1	1	4
Statistics	1	1	1	1	0	1	5
Probability	1	0	0	0	1	0	2
TOTAL	5	4	2	2	3	4	20

Mathematics Interest Questionnaire (MIQ): this is a 10-item inventory questionnaire with four measurements of two positive and two negative responses mode to determine the students' interest in mathematics. It has two sections (A and B), section A required information on biographic data of the students while section B of the instrument contains ten (10) items developed and adopted from the Likert's (1973) with four options of modified scale response mode of strongly agreed (SA) coded as 4, Agreed (A) coded as 3, disagree (DA) coded as 2 and strongly disagree (SD) coded as 1. Each option carries weight in the order of priority from four to one in positive interest responses and from one to four in negative interest responses.

Validation of the Instruments

The Content Validity of both MPT and MIQ were carried out by two senior lecturers from Department of Education and Mathematics of University of Maiduguri.

Pilot Testing: Both the MPT and the MIQ were subjected to pilot testing in one of the schools not selected for practical, with a group of 30 students. The MPT was administered to the students twice during pilot testing with the interval of two weeks using test-retest method in line with Tuckman (1975) who proposed the minimum interval of two or more weeks between first and second administration. However, unlike MIQ test items which was administered once. The reliability coefficient of the MPT was calculated using Pearson Product Moment Correlation (PPMC) and found to be 0.82 and 0.89 for first and second tests respectively. This signifies that, the instrument is consistent for the study. The data obtained from MIQ was computed using Cronbach's Alpha and the reliability coefficient of 0.91 obtained therefore, the instrument was reliable for the study.

Data Collection Procedure

The researcher administered the instruments (MPT) and (MIQ) to the two groups experimental and control to determined their interest and performance before the treatment (pre-test), post-test was administered to determine the performance and interest of the groups after the treatment. Post-posttest was administered after the interval of two weeks to determine the retention ability of the two groups.

Procedure for Data Analysis

The data collected were analyzed using Independent Samples Z-test and Mann-Whitney U-test in testing the null hypotheses at alpha (α) = 0.05 level of significance, because there are two groups and the scale of measurement are interval and ordinal. The Statistical Package for Social Sciences (SPSS) version 20.0 was used.

Result Presentation

Hypothesis One: There is no significant difference between the mean scores performance of students taught mathematics with the use of advance organizer and those taught without the use of advance organizers?

Table3: the posttest scores between experimental and control groups were analyzed using the Z-test the summary of the results were shown in table below

Study Group	N	Mean	SD	Df	Z	p-value	Effect size	Remark
Experimental	248	85.26	9.99	470	29.73	0.000	1.85	S
Control	224	60.75	13.26					

The result from table 3 of posttest on students' academic performance between the experimental and the control group revealed that, experimental group scores ($\text{Mean} = 85.26, \text{SD} = 9.99$) and the control group scores ($\text{Mean} = 60.75, \text{SD} = 13.26$) with ($\text{t} = 26.73, \text{df} = 470, \text{p} - \text{value} = 0.000$) where the p-value of 0.000 which is less than the level of significant ($\alpha = 0.05$) indicates that, there is statistical significant difference in students' performance in mathematics and the effect size of 1.85 also shown a practical significant highlighting the impact of teaching mathematics with the use of advance organizer. Therefore, hypothesis one is rejected.

Hypothesis Two: There is no significant difference in students' level of interest in mathematics between those taught with the use of advance organizer and those taught without the use of advance organizers?

Table 4: the posttest scores b**etween experimental and control groups were analyzed using the U-test the summary of the results were shown in table below**

Group	N	Median	U-test	p-value	r coefficient	Remark
Experimental	248	84.00	16842	0.000	0.958	S
Control	224	58.00				

Results from table 4 revealed that, posttest scores between the experimental and control groups determined with U Test with p-value of 0.000 less than the level of significant (0.05) with large r-coefficient of 0.958 indicating that, there is significant difference in students' interest between two groups in mathematics in favour of experimental group (with the use of advance organizer). Therefore, hypothesis two is rejected.

Hypothesis Three: There is no significant difference between mean scores of students' retention taught mathematics with the use of advance organizer and those taught without the use of advance organizers?

Table 5: the mean scores difference of post-posttest of MPT on retention between the two groups were analyzed using the Z-test, the summary presented in the table below

Group	N	Mean	SD	df	z	p-value	Effect Size	Remark
Experimental	248	75.48	14.26	470	24.36	0.000	1.470	S
Control	224	49.47	17.69					

Results from table 5 on students' retention revealed that, the mean retention scores for the Experimental and Control groups are 75.48 and 49.47 with corresponding SD of 14.26 and 17.69 respectively. The t-test results of (t=13.25, p-value=0.000) indicating that, there is significant difference in the students' retention and the effect size of 1.470 is notably large, highlighting the practical significance of this difference in favour of experimental group. Therefore, the use advance organizers in teaching mathematics influences students' retention. Thus, hypothesis three rejected.

Hypothesis Four: There is no significant difference in the mean scores of academic performance between male and female students taught mathematics with the use of advance organizer only?

Table 6: the mean difference of performance for MPT between male and female students of experimental group taught mathematics with the use of advance organizers only

Post post-test for performance							
Gender	**N**	**Mean**	**SD**	**df**	**Z-test**	**p-value**	**Effect size**
Male	218	85.27	10.33	470	0.049	0.108	0.0068
Female	254	85.20	8.58				

Findings from table 6 revealed that, z-test investigating the mean difference in performance between Male and female students taught mathematics with the used of Advance Organizers only. The mean performance for males is 85.27 with SD of 10.33, while for females the mean performance is 85.20 with SD of 8.85. The z=0.049, with high p-value of 0.108, indicating there is no statistical significance difference in the performance between male and female students. The effect size is small at 0.0083, suggesting a negligible practical difference in academic performance between male and female students.

Hypothesis five: There is no significant difference in the mean scores of students' level of interest between male and female taught mathematics with the use of advance organizer only?

Table 7: the scores difference of interest between male and female students of experimental group taught mathematics with the used of advance organizers only

Post post-test for level of interest						
Gender	**N**	**Median**	**U-test**	**p-value**	**r coefficient**	**Remarks**
Male	218	84	1927.6	0.534	0.785	NS
Female	254	82				

Findings from table 7 revealed that, the analysis of the U-test on students' interest between male and female taught mathematics with the used of Advance Organizers revealed that, the median scores were 84 and 82 for male and female students respectively. The U-test was 1927.6 with p-value 0.534 which indicated that, there is no significant difference in students' interest between male and female taught mathematics with the used of Advance Organizers, the r-coefficient of 0.785 signifies any practical difference between the male and female groups in terms of interest. Therefore, both the performance and interest were retained. Thus, hypothesis four is retained.

Discussion of Results

Results from table 3 revealed that, there is significant difference in the students' performance in mathematics between two groups. The repercussion of the result is that, teaching mathematics with the used of advance organizers enhance students' academic performance compared to conventional teaching method. This finding is in line with Nyabwa and Githuaj (2022) who examined on the effects of advance organiser strategy and how the use of advance organisers boost learning of mathematics indicated that, students taught using advance organisers had significantly higher scores in MAT than those taught in the conventional teaching method.

Results from table 4 revealed that, there is significant difference in students' interest in mathematics between two groups. This finding resonates with findings of Bukar, et al (2020) on the impact of video advance organizers on NCE students' interest and retention in geomorphology concepts and results revealed that, there was higher significant difference in students' interest in geomorphology concepts between the two groups too. The evidence suggests that, integrating advance organizers into mathematics instruction influences students' interest in the subject.

Results from table 5 revealed that, there is significant difference in students' retention in mathematics between the two groups. The finding is in line with the discovery of Abubakar (2016) on the effect of advance organizers on students' performance and retention in conservation concepts in biology results revealed that, there were significant difference between the mean scores of academic performance and retention of students the two groups.The study highlighted the positive impact of advance organizers on mathematics performance retention and suggested that, teaching mathematics with the use of advanced organizers improves students' retention in the subject.

Results from table 6 revealed that, there is no significant difference in the students' performance between the male and female taught mathematics with the used of advance organizers only. This finding agrees with the findings of many researchers on gender disparity, such as; the finding of Abubakar in (2016) on the effect of advance organizers on students' retention and performance in conservation concepts in biology and revealed that, there was no significant difference in the performance between male and female students taught with advanced organizers. Nyabwa and Githuaj (2022) on the effects of advance organiser strategy on secondary school students' mathematics achievement and there was no gender difference.

Results from table 7 revealed that, there was no difference in students' level of interest between the male and female taught mathematics with the used of advance organizers only. This result tallies with the study of Bukar, et al (2020) on the impact of video advance organizers on NCE students' interest in geomorphology concepts and there was no gender disparity. Thus, utilizing advance organizes in teaching mathematics does not signifies difference in performance and interest best on gender.

Summary of Major Findings

1. There is significant difference in the students' performance in mathematics between those taught with the used of advance organizers and those taught without the use of advance organizers
2. There is significant difference in students' interest in mathematics between those taught with the used of advance organizers and those taught without the use of advance organizers
3. There is significant difference in students' retention in teams' performance and interest in mathematics between the two groups.

4. There is no significant difference in the performance between the male and female students taught mathematics with the used of advance organizers only.
5. There is no significant difference in the level of interest between the male and female students taught mathematics with the used of advance organizers only.

Conclusion

Based on the findings of this study it concludes that, the gaining of Academic performance and interest in mathematics can be adopted significantly through the use of Advance Organizer Strategy. Advance Organizer Strategy promotes and strengthens retention in mathematical concepts among students. And it is gender-friendly, creates better in retention in terms of academic performance and interest among male and female students. The study has significantly **contributes** and great implications for educational practices in Nigeria in the following ways; highlights the potential efficacy of Advance Organizer in enhancing students' understanding and application of Mathematical concepts, influences academic performance and interest for the subject, consistent across gender on knowledge retention irrespective of male and female students.

Recommendation

The finding recommends that, teachers should frequently employ the use of Advance Organizer in teaching Mathematical concepts for better gaining of interest, performance and retention in the subject. The professional bodies like MAN, STAN, STEM in collaboration with the FME and SME should embark on nationwide re-training of teachers to implement mathematics instructions based on use of advance organizers through national, state and local seminars, workshops and conferences. The study **suggested** further studies similar to this study should be conducted with the used of advance organizers on another subject to compare the different with the mathematics.

REFERENCE

Abubakar, I. A. (2020). The Impact of Smartphone Usage on Gender and Academic Performance of Pre-Service Teachers in Colleges of Education in Northern Nigeria. Journal of Education and Technology Systems, 49(3), 267-284

Aniaku, O.L. (2012). Effects of guided and unguided inquiry teaching methods on secondary school students' achievement and interest in Biology in Enugu State. An unpublished Ph. D Thesis at University of Nigeria Virtual Library

Ausubel, D. (1960). The Use of Advanced Organizers in Learning & Retention of Meaningful Material. *Journal of Educational Psychology*, 5(15), 267-272.

Bloom, B. S. (Ed.). (1970). Taxonomy of educational objectives. Handbook I: Cognitive domain. New York: David McKay Company.

Bukar, A. M., Ali, A. G. K., Isa, A. M., & Ali, B. A. (2021). The impact of video advance organizers on NCE students' interest and retention in geomorphology concepts in Yobe State Nigeria. *International Journal of Research in Education, 11*(3), 206-220.

Elvia, B. (2020). Significant of smartphone as teaching methods: An educational technology tool for teaching and learning. *International Journal of Innovative Science and Research Technology*, *5*(5), 1634-1638.

Karjanto, N., J. (2022). Sustainable learning, cognitive gains, and improved attitudes in College Algebra flipped classrooms. *Sustainability*, *14*(19), 12500.

Likert, R. (1973). *A Technique for the Measurement of Attitudes.* Archives of Psychology

Mahdi, M., Maryam M. & Adel Z, B. (2020) Using advance organizers to enhance students' motivation in learning Mathematics. *Eurasia Journal of Mathematics, Science & Technology Education, 5*(4), 413-420

Mayer, R. (2003). Learning and Instruction. New Jersey: Pearson Education, Inc

Nyabwa, C, A., & Githuaj, O, J. (2022). the effects of advance organiser strategy on secondary school students' mathematics achievement and Challenges of teachers with pupils in school settings. *The Online Journal of Quality in Higher Education*, *3*(2), 52-63.

Oyeniyi, A,D. (2019). Effects of outdoor activities and Advance Organizer teaching strategies on students learning outcome in secondary school Basic Science in Ekiti State. An Unpublished Ph.D Thesis. Ekiti State University, Ado-Ekiti, Ekiti State

Tuckman, B.N. (1972), Conducting Educational Research, New York: Harcourt Brace Jonanorich. inc.

Umoetuk, G. (2020). Methodology of different approaches in classroom as a reform-oriented to teaching mathematics. *Journal of Science, Technology, Education & Mathematics (JSTEM),* 6*2*(8), 291-305.

West African Examination Council (2010-2016). Chief Examiners Annual Reports: Senior Secondary School Certificate Examinations Results in Chemistry, May/June Option, 2010-2016. (Nigeria) Lagos.