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EFFECT OF GRAPHICAL-SYMBOL TEACHING APPROACH ON SECONDARY SCHOOL STUDENTS' MENTAL ABILITY IN NUMBER AND NUMERATION IN ANAMBRA STATE

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ABSTRACT

The study investigated the effect of graphical-symbol teaching approach on secondary school students' mental ability in number and numeration in Anambra State. Four research questions and seven hypotheses guided the study. It study adopted quasi-experimental design, specifically; pre-test post-test nonrandomized control design was used. The population comprised 18,336 (7,966 males and 10,370 females) Senior Secondary two (SS2) students. A sample size of 280 SS2 students (119 males and 161 females) drawn using multi-stage sampling procedure from six out of 49 Co-educational secondary schools in Awka Education Zone was involved in the study two from department of science education and measurement and evaluation both in faculty of education Nnamdi Azikiwe University Awka and one from the department of Mathematics Education Federal College of Education (Technical) Umunze. General Mental Ability Test (GMAT) were used for data collection. The instruments were validated by three expects. Kuder- Richardson (K-R 20) was used to determine the reliability coefficient of GMAT which was found to be .85 and .85 respectively. The experimental procedure was done using the stages in GSTA in treatment groups and stages in TTA. Mean and standard deviation were used to answer the research questions while analysis of covariance was used to test the null hypotheses at .05 alpha levels. The findings of the study revealed among others that, students taught number and numeration using graphical-symbol teaching approach (GSTA) had higher mean mental ability scores and higher mean achievement scores than those taught using traditional teaching approach (TTA). Hence, there are significant differences between the mean mental ability scores of students taught number and numeration in favour of GSTA group. Also, GSTA enhanced male and female students' mental ability in number and numeration more than the TTA. Based on the findings it was recommended that secondary school teachers of Mathematics should adopt the use of GSTA when teaching number and numeration (branch of Mathematics). Also, Ministry of Education in partnership with STAN and MAN should train in-service Mathematics teachers on the use of GSTA in form of Mathematics instruction.

Keyword: Graphical-Symbol, Teaching Approach, Students, Mental Ability and Number and Numeration.

Introduction

Science Technology Engineering and Mathematics (STEM) is established to help train young individual learners to grow in the areas of science, technology, engineering and mathematics for stable and improved technological society. Technology, science and mathematics are regarded as a vehicle for economic and social development in a country. This can only be possible depending on the quality of scientists and Mathematicians produced through science education. This implies that nation's advancement in science depends to a large extent on its strong Mathematics education programmes.

Mathematics is an essential discipline that is recognized as a tool for solving everyday problem faced by individuals. According to Santosh and Laurent (2015), Mathematics is a methodical application of matter because the subject makes a man and its environment methodical and systematic. The authors further asserted that, Mathematics is the cradle of all creations, without which the world cannot move an inch. For example, the cooks, farmers, carpenters, mechanic, shop keeper, doctors, magicians and so on, all needs Mathematics in their day to day life. Lathan (2021) concluded that all animals use Mathematics in everyday of their life for existence.

Snails make their shells, spiders design their webs, and bees build hexagonal combs; there are countless examples of mathematical patterns in nature's fabric. According to Lathan (2021), anyone can be a mathematician and posses Mathematics knowledge, if the individual or person is given proper guidance and training in formative period. This is because, Mathematics knowledge is used to enhance a person's reasoning, problem-solving skills and in general, the ability to think. Sunday, Akamu and Fajiemidegba (2014) stated that Mathematics knowledge makes every living individual life orderly and prevent chaos. They also added that, certain qualities that are nurtured through Mathematics knowledge are the power of reasoning, creativity, abstract or spatial thinking, critical thinking, problem-solving ability or ability to solve problem and even effective communication skills.

One of the trusted instruments for solving problem or challenges facing the society is Mathematics which is widely regarded as the science of all sciences and art of all arts which has its branches (Scholer and Amalraj, 2016). According to Scholer and Amalraj, the branches of Mathematics include number theory, algebra, geometry, arithmetic, combinatoric, topology and Mathematical analysis. Numbers theory is one of the branches of Mathematics concerned with properties of the positive integers (eg 1, 2, 3, …). Sometimes it is called higher arithmetic and it is one of the oldest and most natural of mathematical pursuits. Algebra deals with symbols or variables and uses arithmetic operations like +, -, x and ÷ to find the unknown quantities represented by these variable (Irshad *et al*, 2018). Irshad *et al* further asserted that geometry is the branch of Mathematics that is concerned with the shape of individual objects, spatial relationships among various object and the properties of surrounding space.

Arithmetic consists of the study of numbers, especially concerning the properties of the traditional operations of them, that is, addition, subtraction, multiplication, division, exponentiation and extraction of roots (Santosh and Leurent, 2015). Combinatoric is the field of Mathematics concerned with problems of selection, arrangement and operation within a finite or discrete system. Topology is a branch of Mathematics, sometimes

referred to as rubber sheet geometry while mathematical analysis is the branch of Mathematics that is dealing with limits and related theories such as differentiation, integration, measure, sequence, series and analytic functions. All these branches of Mathematics are used to find solutions to everyday life problems such as power supply and food production. This stands to reason therefore that Mathematics can be applied to every aspect of things in life including the economic development of any country like Nigeria according to Okigbo and Okeke (2017).

Despite the importance of Mathematics to national development of any nation like Nigeria, the achievement in Mathematics by senior secondary school students in Nigeria is not quite encouraging just as shown by the data collected from WAEC office Anambra state. In the year 2013, out of 1,238,163 that enrolled in May/June WAEC Mathematics examination only 676,860 passed with grades A1 to C6 containing only 54.67% of the students that enrolled. Secondarily, in the year 2014, out of 1,259,964 that enrolled in May/June WAEC Mathematics examination only 485,664 passed with grades A1 to C6 containing only 38.55% of the students that enrolled. In 2015, out of 1,593,442 that enrolled in May/June WAEC Mathematics examination only 544,638 passed with A1 to C6 containing only 34.18% of the students that enrolled. In 2016 out of 1,544,234 that enrolled for May/June WAEC Mathematics examination only 597,310 passed with A1 to C6 containing only 27.31% of the population of students that enrolled in the year. Similarly, out of 1,558,349, that enrolled in 2017 only 517,216 passed with A1 to C6 pass containing only 33.19%, of the population of students that enrolled in that year. In 2018, out of 1,553,727 that enrolled for May/June WAEC Mathematics examination only 467,671 passed with A1 to C6 making 30.10% of the population of students that enrolled in that year.

In 2019, out of 1,563,829 that enrolled for May/June WAEC Mathematics examination only 486,351 got up to with C6 and above making 31.10% of the population of students that enrolled that year. In 2020, out of 1,598,442 that enrolled for May/June WAEC Mathematics examination only 559,455 got up to C6 and above making only 35.00% of the students that enrolled that year. In 2021 out of 1,573,849 only 1,274,784 got A1 to C6 and above making 81.7% of students that enrolled. Finally, in year 2022, out of 1,593,442 that enrolled in May/June WAEC Mathematics examination only 602,714 passed between C6 – A1 containing only 37.82% of the students that enrolled in WAEC that year. Going from these reports, it is clearly understood that from 2013 – 2022 (over a 10 years period), the percentage pass from A1 to C6 is not up to 50% accept in 2013 and 2021 (Appendices A pages 118 refer). However, there was a remarkable improvement recorded in 2021 (81.7%) which suddenly dropped in 2022 (37.82%). This suggests that all is not well with the teaching and learning method used in teaching Mathematics in Nigeria.

More so, the WAEC Chief examiners for Mathematics from 2013 to 2015 (from WAEC office Anambra State) reported that students performed poorly in areas of set theory, distance and bearing, inequality, vectors, statistics, numbers and numeration among others. In 2016, the WAEC Chief Examiner revealed that lack of basic mathematical tools in number and numerations may form the bases of poor performance in Mathematics in areas like approximation, rounding up and collusion among candidates. WAEC Chief Examiner's report from Anambra state in

2017 also noted inability to identify the principle or concepts to be used in solving a problem, adherence to the rubrics of question and poor interpretation of questions in the areas of number and numeration which forms the bases of mensuration, set theory and quadratic equation which were the areas the candidates had a massive failure.

In 2018, Chief examiners from Anambra State reported that candidates performed poorly in the areas of circle geometry and its application, geometrical construction, graphical solution to quadratic equation and in 2019 they reported again that candidates do not do well in the areas of set theory, graphical solution to quadratic equation. In addition, the WAEC Chief examiners' reports from Anambra state (2020 – 2022), showed that candidates performed poorly in inclusion of essential details and units, representing given information in appropriate diagram, circle geometry and its application, geometrical construction, graphical solutions to quadratic equations, reading from the graph and inadequate knowledge of drawing graphs and reading from it. According to all these reports, the poor academic achievement on Mathematics may be as a result of fundamental knowledge in Mathematics tools like in number and numerations.

The researcher is compelled to ask, could it be that the approaches used in teaching different mathematical concepts in secondary schools over the years were not proper? According to Okigbo and Okoli (2016), a teaching approach comprises the principles and methods used by teachers to enable students learn. The authors further opined that, teaching approach determines the activities of teachers and students, the quality of the teaching process, but more importantly engage, motivate and reach the students in their classes, whether in person or online. According to Lathan (2021), there are many types of teaching approaches which include; teachers – centered, student – centered / constructivist, project based learning, Montessori, inquiry based learning, flipped classroom, co-operative learning, personalized education and graphical symbol approach. These approaches could be used in teaching various areas of science and Mathematics.

Teacher-centered approach include traditional method of teaching, direct teacher instruction, lecture teaching approach, expository method among others. Over the years, many teachers and instructors prefer this teacher-centered teaching approach hence, Omokaadejo (2015) reported that the Nigerian classroom whether primary, secondary or tertiary institutions level tends to resemble a one person show with a captain (teacher) who often command audience (students). One of the oldest teacher-centered approaches to teaching is the traditional approached / method of teaching. Guisti (2018) defined traditional approach of teaching as teacher-centered approaches to teaching in the sense that the teacher and those up in the high educational hierarchy are considered as the possessor of knowledge to be transferred to the students and such decides how the knowledge transfer takes place.

Advantages of traditional teaching approach as asserted by Gogo and Nduka (2017) include interactive, motivating, accessible, organized, punctuality, social interactions, extracurricular activities, passive listeners and face to face interactions. The author further outlined disadvantages of traditional teaching approach as thus: generalized learning, no flexible time, expensive, teacher-centered learning, time-bound, high cost, generic methodologies, theory-based lessons, physical presence of teacher and learner. This is also in line with what Oguguo and

Uboh (2020) stated about disadvantages of traditional teaching approach. Based on the disadvantages of teacher-centered approach in teaching, the researcher is motivated to observe the effect of student-centered approach such as graphical-symbol teaching approach on the mental ability and academic achievement of secondary school students in number and numeration (branch of Mathematics).

Graphical symbol can be defined as the representations of direct reality, which comes in the form of object, chart, diagrams, maps, sketches, cartoons and symbols. Graphical-symbol teaching approach seeks to reveal patterns which indicate the problem with either the model or the data and often are useful in suggesting ways to improve the data analysis such as in the transformation of the variables or other specification of the model. According to Santosh and Laurent (2015), graphical-symbol teaching approach is a visually perceptible figure with a particular meaning used to transmit information independently of language. Helingo, Amin and Masriyah (2018) opined that graphical symbol teaching approach is an icon that denotes a program or a command or a data file or a concept in a graphical user interface. According to the authors, the approach can appear in form of visual images or designs to represent figures in Mathematics on some surface, such as a well, canvas, screen, paper or stone, to inform, illustrate, or entertain especially among children to represent concepts in Mathematics.

More so, in representing concepts in Mathematics using graphical teaching approaches, the teacher should observed the following procedures which includes; Choose the right type of graphic or diagram, create clear and consistent graphics and diagrams and integrate graphics and diagrams with text (Santosh and Laurent, 2019). The author further explained that, the graphics/object must be directly relevant to the content, the graphic should be big enough to be seen by the farthest students and objects/graphics also must be attractive and the image should be aesthetically presented to maintain good taste indicating that, the students learn more based on what they see and practice.

Santosh and Laurent (2015) summarized the importance of graphical symbol approach to include: facilitation and improving learning, understanding content, flexibility to use in teaching and learning, increases structured thinking, supports creative, personalized reports for more engaging and stimulating visual presentations, improves communication and ability to show the whole picture of said concept. Irshad *et al* (2018) added that, graphical symbol teaching approach is commonly used to determine whether the data support an interpretation of mixing of two potential sources or fractionation of a single source in Mathematics concepts. This is to say that, graphical symbol approach may help secondary school students understand and increase their mental ability towards learning the Mathematics concepts.

Mental ability is the power to learn or retain knowledge in Mathematics, the ability to understand the calculative numeral, facts and significance of numbers. According to George, Scholer and Amalraj (2016), mental ability represents a person's brain power in different areas of competence. The psychologist agrees that the term mental ability describes a person's ability to learn and remember information, to recognize concepts and their reaction and to apply information to their own behaviour in an adaptive way especially among learners or students (George *et al, 2016).* According to Adewale, Njewuihe and Ogunshola (2016), student's test of general

mental ability include scales that measure specific constructs such as verbal, mechanical, numerical, and social ability to ascertain their academic achievement in a said concept.

Anggrain, Budyono and Pratiwi (2018) observed that, female physics students have better result in four (4) indicators of mental ability constructs than males base on the high mental ability of the female students in Matemalika Universities Ahmad Dahlen. Foremi, Kinde and Babatunde (2017) revealed that there was no significant difference between the performance of students between the ages of 12 to 15 years plus (12 – 15 plus) on basic technology multiple choice test. According to the authors, there was no significant difference between the performance of male and female students on basic technology multiple choice test. Despite the fact that there was no significant difference between students' performance in terms of age, the mean value revealed that students at tender age (12 -13 years) performed better than their counterparts who are older in age in basic technology multiple choice test. This may be as a result of high mental ability in science related subject from early stage of human mental behavioural according to Foremi *et al* (2017).

Behaviourism learning theory was proposed by John B Watson but in 1930 B. F. Skinner suggested that the theory should be converted to behaviour which includes cognition and emotions, example of individual mental ability. Behaviorism learning theory was the first to scientifically explain both animal and learning. The theory focuses on measurable changes in behaviour that result from organism interactions with the environment. Educational adaptations of behaviourism learning theory are concerned with what students do as a result of environment and the state of their mental ability and academic achievement.

The behaviourism learning theory (BLT) further suggested that teachers can directly influence how students' behave especially when new learning approach or method is introduced to them like graphical symbol approach. This is the reason the researcher intends to use behaviourism learning theory to support the present study which is the effect of graphical symbol approach on secondary school student's mental ability in number and numeration in Anambra state.

Statement of the Problem

Realizing the importance of Mathematics for national development, a lot of students tend to register Mathematics in secondary school because the subjects is general and compulsory to all students that registered for WAEC examination. Mathematics is compulsory for students who wish to attain any higher institution especially in science related courses in Nigeria. Despite these facts, it is very disheartening to see from the evidence provided by WAEC reports that out of millions of candidates that registered for the subject in WASSCE, their achievement in every year is still below 50% each year from the year 2013 to 2022 accept in 2013 and 2021. It is also noted that, from the Chief examiners report collected from the Anambra state WAEC office each year from 2013 to 2022, number and numeration is one of the fundamental concepts in Mathematics that students' weaknesses are observed based on the mental ability data of the said years.

The situation may be as a result of teaching and learning methods/ approaches used in teaching and learning the subject. Some teaching and learning approaches such as graphical symbol approach have proven as a treat to students' mental ability

in many school subjects. The problem of this study is 'what is the effect of graphical-symbol teaching approach on secondary school students' mental ability in number and numeration in Anambra State?'

Aim and Objectives of the Study

The purpose of this study was to determine the effect of graphical-symbol teaching approach on secondary school students' mental ability and academic achievement in number and numeration in Anambra State. Specifically, the study will determine the;

1. Mean mental ability scores of secondary school students taught number and numeration using graphical-symbol teaching approach (GSTA) and that of those taught using traditional teaching approach (TTA).
2. Mean mental ability scores of male and female students taught number and numerations using graphical-symbol teaching approach (GSTA) and that of those taught using traditional teaching approach (TTA).
3. Interaction effect of teaching approaches (GSTA and TTA) and gender on mental ability of secondary school students in number and numeration.

Research Questions

The following research questions were guided this study:

1. What are the mean mental ability scores of students taught number and numeration using graphical-symbol teaching approach (GSTA) and those taught using traditional teaching approach (TTA)?
2. What are the mean mental ability scores of male and female students taught number and numeration using graphical-symbol teaching approach (GSTA) and those taught traditional teaching approach (TTA)?

Statement of Hypotheses

The following null hypotheses were tested at.05 level of significance:

1. There will be no significant difference between the mean mental ability scores of students taught number and numeration using graphical-symbol teaching approach (GSTA) and those taught using traditional teaching approach (TTA).
2. There will be no significant difference between the mental ability scores of male and female students taught number and numeration using graphical-symbol teaching approach (GSTA) and those taught using traditional teaching approach (TTA).
3. There will be no interaction effect of teaching approaches (GSTA and TTA) and gender on secondary school students' mental ability in number and numeration.

Research Method

The study adopted a quasi – experimental research design. Four research questions guided the study and seven hypotheses were tested at .05 alpha level. The population comprised 18,336 Senior Secondary two (SS2) students for 2022/2023 session in 263 public secondary schools in Anambra State. The sample size of 280 SS2 students was obtained using purposive and simple random sampling techniques. The instruments for data collection were General Mental Ability Test (GMAT) validated by three experts. The reliability of GMAT was established using Kuder-Richardson Formula 20 at 0.85. The experimental group was taught using GSTA while the control group was taught using TTA. The data generated through pre-test and post-tests were analyzed using mean, standard deviation and Analysis of Covariance.

Presentation/Result

Table 1: Mean Mental Ability Scores of Students Taught Number and Numeration using Graphical Symbol Teaching Approach (GSTA) and Traditional Teaching Approach (TTA)

		Pretest		Posttest		
Groups	N	Mean	SD	Mean	SD	Mean Gain
GSTA	148	11.57	3.80	24.81	2.18	13.24
TTA	132	9.96	2.60	22.11	2.23	12.15

The result presented in Table 1 reveals the pretest and posttest mental ability scores of students taught number and numeration using graphical-symbol teaching approach (GSTA) and those taught using traditional teaching approach (TTA). The pretest mean mental ability scores for the groups in the GSTA and TTA are 11.57 and 9.96 with standard deviation scores of 3.80 and 2.60 respectively. The posttest mean mental ability scores are 24.81 and 22.11 with standard deviation scores of 2.18 and 2.23. The standard deviation scores for the pretest for both groups were higher than the standard deviations for the posttest. This suggests more variability in the pretest mean mental ability scores of the students than the posttest mean mental ability scores. More of the scores near the mean in the pretest than in the post test. Since the pretest mean mental ability score is smaller than the posttest mean mental ability score, in both groups, the treatment which is GSTA improves students' mental ability in number and numeration than TTA.

More so, the mean gain mental ability scores of students taught number and numeration using graphical-symbol teaching approach (GSTA) and those taught using traditional teaching approach (TTA) are 13.24 and 12.15 which depicts that the students in the GSTA taught number and numeration have higher mental ability score than those taught the same Mathematical concept of number and numeration using TTA.

Table 2: Mean Mental Ability Scores of Male and Female Students Taught Number and Numeration using GSTA and TTA

		Pretest		Posttest		
Groups	N	Mean	SD	Mean	SD	Mean Gain
GSTA	148					
Male	60	12.58	4.35	25.52	2.04	12.94
Female	88	10.88	3.2	24.33	2.15	13.45
TTA	132					
Male	59	9.7	2.71	22.93	2.14	13.23
Female	73	10.15	2.51	21.43	2.83	11.28

The result presented in Table 2 reveals the mean mental ability scores of male and female students taught number and numeration using graphical-symbol teaching approach (GSTA) and those taught using traditional teaching approach

(TTA). The pretest means mental ability scores of male and female students for the groups in the GSTA and TTA are 12.58, 10.88,9.7 and 10.15 with standard deviation scores of 4.35, 3.2, 2.71 and 2.51.The posttest means mental ability scores of male and female students for the groups in GSTA and TTA are 25.52, 24.33, 2.14 and 2.83 with standard deviation scores of 2.04, 2.15, 2.14 and 2.83.The standard deviation scores for the pretest mean mental ability scores for male and female students in both groups were higher than the standard deviations posttest mean mental ability. This suggests more variability in the pretest mean mental ability scores of the male and female students than their posttest mean mental ability scores. More of the scores near the mean in the pretest than in the post test. Since the posttest mean mental ability scores of female students are less than that of their male counterpart in both groups in the Mathematical concept of number and numeration taught, treatment group and control group favours male students mental ability than their female counterpart in number and numeration.

Table 3: ANCOVA Test of significant deference in the mean Mental Ability Scores of students in the two Groups

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	510.912[a]	2	255.456	2.599	.076	.018
Intercept	12924.839	1	12924.839	131.514	.000	.322
Pretest	.487	1	.487	.005	.944	.000
Group	474.708	1	474.708	4.830	.029	.017
Error	27222.730	277	98.277			
Total	182834.000	280				
Corrected Total	27733.643	279				

Data shown in Table 5 reveals the ANCOVA results on the effect of graphical symbol teaching approach and traditional teaching method on students' mental ability on number and numeration. The results show a significant difference F (1, 277) = 4.830, p = .029< .05, η^2_p = .017 in the mean mental ability scores of students taught number and numeration using two teaching methods (GSTA and TTA). In all, the null hypothesis which stated that there is no significant difference between the mean mental ability scores of students taught number and numeration using graphical-symbol teaching approach (GSTA) and those taught using traditional teaching approach (TTA) is rejected. Hence, there is significant difference between the mean mental ability scores of students taught number and numeration using graphical-symbol teaching approach (GSTA) and those taught using traditional teaching approach (TTA) in favour of students in experimental group (GSTA).

Table 4: ANCOVA Test of significant deference in the mean Mental Ability Scores of Male and Female Students in the two Groups based on Gender

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	510.912[a]	2	255.456	125.634	.000	.625
Intercept	12626.539	1	12626.539	.001	.979	.000
GSTA/TTA Pretest	.487	1	478.601	82.242	.000	.830
Ender	474.708	1	1.458	.015	.903	.000
Error	27222.730	277	98.546			
Total	182834.000	280				
Corrected Total	27733.643	279				

The data presented in Table 6 shows the ANCOVA results in the mean mental ability scores of male and female students taught number and numeration using graphical-symbol teaching approach (GSTA) and those taught using traditional teaching approach (TTA).The results reveal no significant difference in the mean mental ability scores of male and female students taught number and numeration using GSTA and those taught using TTA; F (1, 277) = .015, p = .903> .05, η^2_p = .000. Therefore, the null hypothesis is not rejected. Hence, the result shows that there is no significant difference between the mean mental ability scores of male and female students taught number and numeration using graphical-symbol teaching approach (GSTA) and those taught using traditional teaching approach (TTA).

Table 5: **Interactive Effect of Teaching Approaches and Gender on Students Mental Ability Scores in Number and Numeration**

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	510.912[a]	2	255.456	1.777	.000	.625
Intercept	12626.539	1	12626.539	.001	.184	.000
Groups Posttest	.487	1	478.601	2.839	.000	.830
Gender	474.708	1	1.458	.015	.093	.000
Error	27222.730	277	98.546			
Total	182834.000	280				
Corrected Total	27733.643	279				

Data shown in Table 9 reveals the ANCOVA on the interaction between the teaching approaches (graphical symbol approach and traditional teaching approach) and gender (male and female) on the students' pretest and posttest mental ability mean scores in number and numeration. The tables reveal no interaction $F(1, 277) = .015$, p = .093, η^2_p = .000. Thus the null hypothesis is not rejected.

Discussion

The results are presented alongside the major issues of this study has shown that the students taught Mathematics concept of number and numeration using graphical symbol teaching approach performed significantly better in General Mental Ability Test (GMAT) than those taught the same concept with traditional teaching approach. The difference may be as a result of the fact that graphical symbol teaching approach facilitation and improving

learning and understanding content. This finding is in consonance with the research of Duyilem and Babafemi (2019) who observed that Biology students taught with graphical symbol approach had a higher mental ability scores than those taught with lecture method. The finding is also in line with Lokman, Asiye, Yasemin, Taner, Murat, and Gülşen, (2020) and Fei, Eiji, Yajia, Mianzhen, Zhiming and Xiaorong (2006) whom in their different studies observed that there was a great performance among hard to hear students' mental ability using graphical symbol and there is a positive synergy in relationship between mental ability, psychological work performance and graphical teaching approach. The finding above could also be as a result of psychological work performance and new mental ideas which come as a result of use of graphical symbol teaching approach. The result from the traditional teaching approach suggested the need to also adopt other teaching approaches in addition that would likely develop adequate content understanding in Mathematics concept of number and numeration in our secondary schools. This implies that the students in the treatment group have significant higher gain in their content understanding than those in the control group.

More so, the ANCOVA analysis indicated that there is a significant difference between students' mental ability scores in the treatment group (GSTA) and in the control group (TTA) in favour of GSTA. The findings of this study is not surprising because GSTA significantly increases students' mental ability and it is flexible to use in teaching and learning according to Soni, (2020). Hence, one would be in a position to say that the students taught using GSTA has a better increased mental ability which help them to learn flexibly in the Mathematics concepts of number and numeration.

The finding has shown that graphical symbol teaching approach enhanced male and female secondary school students' mental ability in Mathematics concept of number and numeration than their counterparts in traditional teaching approach. The difference may be as a result of the fact that graphical symbol teaching approach increases structured thinking, supports creative and personalized reports among individual irrespective of gender. The finding of the study in consonance with Duyilem and Babafemi (2019) who observed that Biology female students taught with graphical symbol approach had a higher mental ability score than their male counterpart but the both gender had a high mental ability score than their counterparts in control group. From table 2 male and female scores in GSTA is higher than their counterpart scores in TTA. In GSTA session, mean gain of male students is 12.94 and that of female is 13.45 then the difference in main gain is 0.15 in favour of female students, the slight difference may be as a result of level of interaction between female while learning with GSTA. But then, GSTA has reduced the female domination to the barest minimum by encouraging equal participation.

Also the ANCOVA analysis indicated that there is no significant difference between the mean mental ability scores of male and female students taught number and numeration using graphical-symbol teaching approach (GSTA) and those taught using traditional teaching approach (TTA). The findings of this study is not surprising because both teaching approaches enhanced male and female secondary school students' mental ability in Mathematics concept of number and numeration though more improved mental

ability score was found in graphical symbol teaching approach but it was not significant.

The study reveals no interaction effect of teaching approaches (GSTA and TTA) and gender on secondary school students' mental ability in number and numeration. The finding is in conformity with Duyilem and Babafemi (2019) who observed no interaction effect between teaching approach, gender and mental ability of the students. The no interaction effect of teaching approaches and gender on secondary school students' mental ability in number and numeration could be that the teachings approaches have no boundary to male and female secondary school students' mental ability in Mathematics concept of number and numeration.

Conclusion

The study concluded that graphical symbol teaching approach significantly improved students' mental ability in Mathematics concept like number and numeration irrespective of gender. The conclusion is that graphical symbol teaching approach is an effective approach for the teaching and learning of Mathematics concept. The graphical symbol teaching approach is also activity-oriented thus making it possible for the students to retain more of the Mathematic concepts because it increases students' mental ability. It can also be concluded that when Mathematics teachers adopt graphical symbol teaching approach, student to student interaction increases thereby making students to take responsibility for their learning.

Recommendations

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

1. Teachers should be encouraged by curriculum planners to employ graphical symbol teaching approach more often in teaching and learning Mathematics concepts.
2. Teachers should direct the presentation of Mathematics lessons away from the traditional teaching approach to a more students-centered approach, visibly oriented and graphic representation like graphical symbol teaching approach.
3. Ministry of education should help teachers through seminars, conferences, support supervision and journal publication to improve their competencies in the use of graphical symbol teaching approach for effective teaching of Mathematics.

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