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EFFECT OF DIFFERENTIATED INSTRUCTION ON ATTITUDE TOWARDS MATHEMATICS AMONG PUPILS IN BASIC SCHOOLS IN FEDERAL CAPITAL TERRITORY, ABUJA, NIGERIA

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ABSTRACT

This study examined the Effect of Differentiated Instruction on Pupils' Attitude towards Mathematics in Basic Schools in Federal Capital Territory, Abuja, Nigeria. Two (2) research questions were formulated to guide this study. Two (2) null hypotheses were also stated and tested at 0.05 level of significance. The research design employed was the Quasi-experimental design. The population for this study is 21,959 pupils. A sample size of 127 pupils were purposively selected. The instruments employed in this study for data collection were questionnaires subdivided into three categories: Mathematics Attitudinal Scale (MAS) used to assess pupils' attitude towards mathematics. The face and content validity of the instruments were established by consulting three experts. The reliability of the instruments was determined by using the test-re-test method of reliability, following a pilot test. Cronbach's Alpha for the Mathematics Attitudinal Scale was 0.79 indicating they were reliable for collecting data for this study. The data collection procedure involved the distribution of the instruments to the pupils, using research assistants for pre-test, to know the entry point of the pupils. A post- test after seven weeks of treatment was conducted to evaluate their attitude. The research questions were analyzed using statistical mean scores and standard deviations. The ANCOVA and t-test were used to test hypotheses. The results showed that differentiated instruction had a positive effect on pupils' attitude after the intervention with differentiated Instruction. It was recommended that teachers should use differentiated instruction methods of teaching to improve the pupils' attitude towards mathematics.

Keywords: Effect, Differentiated, Instruction, Achievement

Introduction

Education is instrumental to the development of man in all ramifications. The high value placed on education is because of the organized structure through which knowledge is passed from generation to generation as well as the relevance of such knowledge in building/advancing human societies. The importance of education at all levels and in all ramifications, cannot be over-emphasized. Abdulghani (2022) stated that education has great value to man as it helps a man in the development of human personality, thoughts, and social skills. It prepares people for life experiences. It designates and places man at a special social status in our society. Education polishes our minds, reinforces our thoughts, and strengthens our character and behaviors toward others. It equips us with information in various fields in general and in our areas of specialization. Thus, education can be viewed as the process of acquiring knowledge and information that leads to a successful future.

The Basic school is the foundation where special rudiments in education are laid before

higher contents are added. At this level, teachers are challenged with different learning difficulties since learners are of different categories and learn differently at different paces. The concern of 21st-century teachers especially in Basic schools in Nigeria is the capacity to deal with different learning challenges among pupils in the same classroom. There are different types of learners with different learning needs and with different interest, attitudes and achievement levels.

The expectation of the school and parents is that the teacher should be able to attend to all pupils irrespective of their learning problems. According to Ojonugwa (2018), one of the greatest challenges of teachers in the twenty-first century is that of coping with the learning needs of pupils with different achievement levels in the same classrooms. Pupils learn in different ways and at different paces. With pupils of different learning ranging from visual, auditory, reading and writing, and kinesthetic in the classroom, the use of a conventional method of teaching may be inadequate to take care of the learning needs of the different types of learners, especially in Basic school. Ojonugwa (2018) further stated that the use of a traditional method of teaching which does not create room for activity-based learning may hinder the learner's attitude and achievement especially in mathematics among Basic school pupils. This may result in poor performance in mathematics.

Some of the disadvantages of traditional teaching strategies have been adjudged as not having the capacity to meet up with the learning needs of the 21st century classroom where emphasis on using innovative teaching strategies such as differentiated instruction, collaborative strategy, flipped classroom, blended learning, and activity-based practices. Other examples of activity-based learning according to Dimitrios, Labros, Nikolaos, Maria, and Athanasios (2013) are information and communication technologies, the Internet as well as various computer programs, simulations, and case studies on real and virtual work environments. The above activity-based learning strategies have different concepts when read with the traditional method of teaching. One of the teaching strategies that may deal with different learning challenges in school is differentiated instruction.

Ojonugwa (2018) portrayed differentiated instruction as a teaching strategy with different teaching techniques designed to assist learners at different learning paces in the same class. Differentiated instruction method provide teachers with diverse strategies during the teaching and learning process to assist learners in meeting their various interest and attitude in the classroom that could bring about individual academic success using specific strategies such as individual learning, computer enhance learning, stimulation of senses, varied homework, peer helper, questioning, open-ended projects amongst others. Differentiated instruction is one of the teaching methods that if properly implemented, may lead to an improvement in the attitude and achievement of pupils in Nigeria's school setting **(**Kalpana, 2014).

Differentiated instruction has been reported to improve the interest, attitude and achievement of different learners. According to Kalpana (2014), differentiated instruction is a teaching strategy that emphasize the careful study of learners' differences in attitude and achievement and the implementation of appropriate techniques capable of improving their attitude and achievement, particularly in mathematics. In addition, Shumba and Awoniyi (2014) opined that differentiated instruction is a strategy of

teaching that required the teacher to have full academic achievement knowledge including the learning needs of all pupils in their classroom. Differentiated instruction is therefore meant to observe and understand the differences and similarities among pupils and use this information to plan instruction. Differentiated instruction has the interest, achievement, readiness, background, and pupil's learning problem at the center of learning. In agreement with the above idea, Tomlinson (2015) asserted that differentiated instruction is tailoring learning instruction to meet the learning needs of individuals such as boosting the attitude and achievement of Basic school pupils in multiplication and division of numbers in mathematics through the use of strategies like learning station, interest centers, teach-up, task board, and open-ended projects".

In this study, differentiated instruction is a teaching strategy that uses activity-based and other teaching strategies in teaching educational concepts and learning experiences to meet the needs and learning challenges of the learners. Some of the strategies are individualized teaching, peer collaboration, activity room, work, and task board, varied and capacity-based assignment, teaching aids learning station, guided personal study time, assisted teaching and activity projects to meet the learning needs of learners of different learning achievements level in the same classroom. Differentiated instruction with its interactive nature and activity-based structures could activate and motivate the interest and attitude of pupils in FCT, Basic schools.

Interest could be conceptualized as the feelings, curiosity or conscious awareness triggered by an individual's attention which attracts him to something. In the view of Renninger and Hidi (2016) interest is the interaction between a person and their surrounding environment, which has a dual meaning as both a psychological state and a set of motivational variables and environmental conditions. They further asserted that dynamics of pupils' interest in science remain a complex and underexplored topic. Given the declining trend of interest in science and mathematics in particular, most teachers in our Basic schools in Nigeria are indifferent in differentiated instruction method which could improve pupil's achievement in mathematics. This could be due to the inability of some teachers to adequately use the strategies or skills appropriately in teaching mathematics pupils in the classroom, for example using different learning styles, like reading, playing of games for learning purposes or peer collaboration amongst others which could capture their interest and aid them in learning. According to Kang and Keinonen (2018), the construct of interest in educational studies is always content-specific, such as "a particular science content, subject, area of knowledge, or activity that increases one's attention, concentration, and affect during engagement. Potvin, Hasni, Sy and Riopel (2018) reported that teachers' pedagogical novelty, such as using inquiry-based approaches in science, indicated the most powerful predictor of science interest, whereas self-concept was not affected by the teaching approaches.

Attitude is the disposition and desperate conviction of people about themselves, objects, and about others. Commenting on the above ideas, Suleiman, Rameli and Ado (2020) asserted that attitude is the organization of behavioural tendencies and beliefs which an individual can hold towards certain groups, symbols, events, or objects. A pupil's attitude can be negative or positive, dislike or like, favourable or unfavourable degree of effect that is associated with a certain subject. Attitude is

an evaluation of any thought or object, and it comprised anything that an individual may hold in his mind. Amatobi and Amatobi (2020) demonstrated that the variable 'attitude' is one of the most potent factors that relate to achievement. In addition, conceptions, attitudes, and expectations of pupils regarding mathematics and mathematics teaching have been a very significant factor underlying their school experience and achievement.

Achievement is the learning outcome of learning activities which comes in the form of grading and feedback in grade form as measured by continuous assessment, test, and examination. According to Khurshid and Abbas (2013) achievement is the learning outcome obtained after tests, assignments, and examinations generated from the school curriculum, and scheme of work. Olusanjo (2013) opined that achievement is scores generated for response to questions presented to the pupil through continuous assessment, tests, examinations, and other measuring tools for promotion and placement in school and society. Ojonugwa (2018) noted that the outcome of examination and assessment revealed the levels of achievement of the pre-stated learning objectives and the levels of learning and change in behaviour that took place in the learner after they have been exposed to learning activities, projects, assignments, and homework with formative and summative evaluation.

There are arguments that the ratio of high achievement in mathematics goes for the male and low achievement goes for females. Gender is a biological state of being classified as male and female. According to American Psychological Association (2016), gender refers to one's sense of oneself as male, female, or transgender. To the World Health Organization (2016), gender refers to the natural and social placement and conditioned characteristics of women and men, such as standard societal norms, laid down roles, and interaction that exists among males and females, especially in primary schools.

The implementation of the 9-Year Basic Education Curriculum which according to Obioma (2012), was developed for the attainment of Education for All (EFA) goals, the critical targets of the National Economic Empowerment and Development Strategies (NEEDS) and the Millennium Development Goals (MDGs), commenced nationwide in September 2008 in Primary one and Junior Secondary one (JSS 1) respectively. The Curriculum produced its first batch of JSS graduates in 2011 and the first set of the beneficiaries at the Primary school level entered the Junior Secondary Schools in 2014.

The philosophy of the 9-year Basic Education Curriculum is centered on the understanding that every learner who has gone through the 9 years of basic education should have acquired appropriate levels of literacy, numeracy, manipulative, communicative and life-skills as well as the ethical, moral, and civic values required for laying a solid foundation for life-long learning as a basis for scientific and reflective thinking. It is pertinent to highlight the three components of the curriculum according to the corresponding levels and the age of the pupils and pupils from primary 1-3, 4-6 and JS 1-3.

The 9 years Basic Education Curriculum (Basic 1-9) has three components namely:

- Lower Basic Education Curriculum for primary 1-3 (age 6-8 years)
- Middle Basic Education Curriculum for primary 4-6 (age 9-11)
- Upper Basic Education Curriculum of

Junior Secondary School (JSS) 1-3 (12-14)

Basic education is the elementary part of education on which the contents of other levels are built. The goals of this level of education as enumerated by the Federal Republic of Nigeria (FRN) in the National Policy on Education are to: inculcate permanent literacy and numeracy, and the ability to communicate effectively, lay a sound basis for scientific and reflective thinking, give citizenship education as a basis for effective participation in and contribution to the life of the society, mold the character and develop sound attitude and morals in the child, develop in the child ability to adapt to the child's changing environment, give the child opportunities for developing manipulative skills that will enable the child to function effectively in the society within the limits of the child's capacity and provide the child with basic tools for further educational advancement, including preparation for trades and craft of the locality.

Based on the identified problems of negative interest, attitudes, and low achievement in mathematics in Abuja, Nigeria's Federal Capital Territory, the need for innovative methods such as differentiated instruction that can improve interest, attitudes and increase achievement in basic school mathematics becomes inevitable. Differentiated instruction is identified as a viable, innovative teaching strategy in this study.

Research Questions

The following research questions guided the study:

1. What is the mean attitude of primary school pupils in mathematics before and after exposure to differentiated instruction and traditional methods in Bwari Area Council?
2. What is the difference between male and female pupils' attitude towards mathematics when taught with differentiated instruction?

Hypotheses

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

H_{o1}: There is no significant difference between the posttest attitudes towards mathematics when pupils are taught with differentiated instruction and traditional lecture method.

H_{o2}: There is no significant difference between male and female pupils' attitudes towards mathematics when taught with differentiated instruction.

Research Method

This research adopted quasi experimental design. It was a pretest, post-test non-randomized control group design. This design, according to Akinbobola, Ikitde, Nkwo & Nkwo, (2016) is used when there is non-randomization of research subjects. This design was adopted because the researcher was unable to randomly select the subjects and assign them to groups, thus intact classes were involved in the study. This design was considered appropriate for this study because it allowed the researchers to compare the two groups; pre-test and post-test scores without disturbing the class setting and enable the researcher determined treatment effects.Quasi-experimental design allowed the researcher to repeat the test after completion of the experiment. The instructional strategy was at two levels (experimental and control groups), while the test level was at two (pre-test and posttest). This approach gave insight into the effects of Differentiated Instruction on pupils' attitude towards Mathematics. The population of the study consisted of 2022/2023 Basic IV pupils in Bwari Area Council of the F.C.T numbering 21,959. A further breakdown of the population indicated that there were 12,388 male and 9,571 female pupils (Bwari Area Council Education Office, 2023). The total sample size comprised of 127 pupils. 62 pupils

(37 males and 25 females) were in the experimental group, which was taught with differentiated instruction, while the second school was the control group with 65 pupils (35 males and 30 females) which were taught with the traditional method. This was in line with Fraenkel and Wallen (2011) who recommended at least 30 pupils per group. Hence, the number was considered adequate for the study. Purposive sampling technique was used to select two schools in Bwari Area Council. Public basic schools were used because of the decline in mathematics achievement. The study used public owned primary schools that have been in existence over ten years and presented pupils for BECE consecutively over five years. A simple random sampling technique, using balloting without replacement was used to select two intact classes from the public primary schools of mixed gender in the study area. Intact classes in both schools used for the study (experimental and control) were scrutinized to ensure that any chosen class in each school had equal entry level in the pre-test. Gender was included to check the gender bias in both groups. The instrument used in collecting the data for the study is: Mathematics Attitudinal Scale (MAS). The Chronbach alpha method of reliability was used to measure the internal consistency of MAS instrument and the index was 0.79.

Experimental Procedure: Before the commencement of the research work, the researchers collected a letter of introduction from the Head of the Department to seek the cooperation of the schools involved. The researchers explained the purpose of the study and the benefit that would be derived if properly conducted. The researchers with the aid of research assistants, who were initially briefed on the nature of the study and how to go about the data collection process, administered the instruments. During the actual research work, the pupils in the treatment and control groups were pre- tested with the instruments before commencing the treatment. The treatment involved teaching the experimental group using Differentiated Instruction (DI) as summarized below.

Week 1 Orientation and Pre-test using Mathematics Attitudinal Scale (MAS).

Week 2 The use of collaborative and teach-up strategies to teach multiplication of two- digit numbers by 1-digit numbers in unit one and 3 by 1-digit numbers in unit two.

Week 3 The researcher used a learning station, task board, and free study time in teaching multiplication of 2 by 2-digit numbers in unit 3, and collaborative, worksheet, and individualized coaching strategies were used in teaching multiplication of 3 by 3-digit numbers in unit 4.

Week 4 Collaborative and questioning will be used in teaching multiplication of factors of numbers and collaborative, task board, and teach-up in teaching word problems in multiplication in unit 6.

Week 5 Discussion, learning station, and teach up in the class interaction with the teacher in teaching division of 2-digit numbers without remainder in unit 7 and collaborative, questioning, and individualized coaching strategies in teaching 3-digit numbers without remainder in unit 8.

Week 6 Collaborative, Independent work, and individualized feedback strategies in a division of 3-digit numbers with remainder and collaborative, questioning, and free study time strategies for word problems in the division of numbers for units 9 and 10 respectively.

Week 7 Administration of Mathematics Attitudinal Scale (MAS) as post- test.

The control group was taught using the conventional method as each lesson lasted for 40 minutes. At the end of the research work, the experimental and control groups were post- tested.

Method of Data Analysis: The pre-test and post-test data obtained from the administration of the Mathematics Attitudinal Scale (MAS) was analyzed using mean and standard deviations for research questions. ANCOVA and t- test were used for testing the hypotheses. ANCOVA is appropriate for tests where pretest is used as covariate while t-test was

used to determine significant difference between the two groups based on the mean scores. All the hypotheses were tested at 0.05 level of significance.

Presentation of Results

Research Question One: What is the mean attitude of primary school pupils in mathematics before and after exposure to differentiated instruction and traditional methods in Bwari Area Council?

Table 1: Pre-Test and Post-Test Mathematics Attitude Mean and Standard Deviation Results of Experimental and Control Groups

	Pre-Test			Post-Test		
Group	**Mean**	**SD**	**Remark**	**Mean**	**SD**	**Remark**
Experimental	2.47	1.11	Negative	2.77	0.63	Positive
Control	2.18	1.00	Negative	2.37	0.48	Negative

Table 1 revealed the mean and standard deviation result of the pre and post mathematics attitude of the experimental and control groups. The result for the experimental group yielded a mean of 2.47 before treatment, indicating negative attitude towards mathematics among the pupils. After treatment, the results for the experimental group yielded a higher mean score of 2.77 than the control group with 2.37. It indicated that those exposed to differentiated instruction had a positive attitude towards mathematics while those exposed to traditional method had negative attitude.

H_{o1}: There is no significant difference between the posttest attitudes towards mathematics when pupils are taught with differentiated instruction and traditional method.

Table 2: Summary of ANCOVA Results of Post Attitude of Pupils in the Experimental and Control Groups

Source	**Type III Sum of Squares**	**Df**	**Mean Square**	**F**	**Sig.**	**Partial Eta Squared**
Corrected Model Intercept	12.817a	2	6.409	40.849	.000	0.397
PreAttitude Group	36.039	1	36.039	229.712	.000	0.649
Error	6.127	1	6.127	39.056	.000	0.24
Total	4.125	1	4.125	26.292	.000	0.175
Corrected Total	19.454	124	0.157			
	886.429	127				
	32.271	126				

a. R Squared = .397 (Adjusted R Squared = .387)

Table 2 shows the Analysis of Covariance comparing the post-test mean attitude of pupils taught Mathematics using differentiated instruction and traditional method while controlling for covariant (pre-test). There was a significant difference in

the mean attitude between the experimental and control groups with F (1, 124) = 26.29, p = 0.000. The null hypothesis was therefore rejected.

The study found that differentiated instruction has a positive (significant) effect on post-test attitude of pupils when covariant effect (pre-test) was controlled. This result revealed that the application of differentiated instruction in the teaching of mathematics accounted for the difference in post-test mean attitude of the pupils.

Ho2: There is no significant difference between male and female in the posttest attitude of pupils towards mathematics in basic schools in F.C.T, Abuja, Nigeria.

Table 3: t-test on the difference between male and female in the posttest attitude of pupils towards mathematics in basic schools in F.C.T, Abuja, Nigeria

Gender	Number	Mean	S. D	t-value	df	Sig(2- tailed)	Decision
Male	37	2.73	.04	-8.76	60	.000	Significant
Female	25	2.61	.03				

Analysis in Table 3 was carried out to find out the difference between male and female in the posttest attitude of pupils towards mathematics in basic schools in F.C.T, Abuja, Nigeria. With the significant values of .000 (less than the 0.05 level of significance), the hypothesis that says that there is no significant difference between male and female in the posttest attitude of pupils towards mathematics in basic schools in F.C.T, Abuja, Nigeria is therefore, rejected and concluded that male and female differ significantly in the posttest interest of pupils in mathematics in basic schools in F.C.T, Abuja, Nigeria.

Summary of Findings

The following findings have been made in this study.

- The study found that those exposed to differentiated instruction had a positive attitude towards mathematics while those exposed to traditional method had negative attitude.
- This result revealed that the application of differentiated instruction in the teaching of mathematics accounted for the difference in post-test mean attitude of the pupils.
- The study found male and female pupils exposed to differentiated instruction differed significantly in attitude towards mathematics in basic schools in F.C.T, Abuja, Nigeria.

Discussion of Findings

The findings of the study are discussed in this section. The study found that pupils exposed to differentiated instruction had high interest in mathematics in basic schools in FCT, Abuja, Nigeria. In a similar study by Ugwuanyi (2022), the study observed the interest of children in both library electronic books had a significant effect on children's achievement in Basic Science than the usual traditional method of teaching.

The study found that those taught with

Differentiated Instruction had positive attitude in mathematics in basic schools in FCT, Abuja, Nigeria. In a study conducted in Turkey by Karadaq and Yasar (2010), they found that the differentiated instruction approach influenced the students' attitudes toward the Turkish course positively.

This study identified improvement in the pupil's achievement after they were taught with differentiated instruction in mathematics in basic schools in FCT, Abuja, Nigeria. In a study by Koeze (2007), it was observed that differentiated instruction approach led to higher students' achievement than other methods.

This study found that differentiated instruction had statistically significant effect on post- test mean interest of pupils in mathematics in basic schools in FCT, Abuja, Nigeria. A similar study by Ugwuanyi (2022) observed that library electronic books had a significant influence on the post-test mean interest of pupils in basic science.

This study revealed that differentiated instruction had a statistically significant effect on post-test mean attitude of pupils in mathematics in basic schools in FCT, Abuja, Nigeria. A study conducted by Zonneveld (2015) observed that there was a significant increase in the post-test mean attitude in mathematics at Western Christian High School, Hull, Lowa as a result of applying the differentiated instruction method.

This study showed that differentiated instruction had a statistically significant effect on post-test mean achievement of pupils in mathematics in basic schools in FCT, Abuja, Nigeria. This is similar to a study conducted by Aranda and Zamora (2017). The study revealed that differentiated instruction had a significant improvement in learners' achievements in Filipino literature and language.

This study found that male and female pupils exposed to differentiated instruction differed significantly in interest in mathematics in basic schools in FCT, Abuja, Nigeria. Contrary to this findings, Winklemann (2009), posits that students of male teachers did not show statistically significant academic growth regardless of student gender. Female students taught by female teachers showed marginally significant growth in reading when compared to male students of female teachers. It mentioned that teacher gender did not have a statistically significant difference in student academic growth in mathematics for either gender.

This study found that male and female pupils exposed to differentiated instruction differed significantly in attitude towards mathematics in basic schools in FCT, Abuja, Nigeria. This was different from a study done by Bain and Rice (2016). Their study observed no statistical significance between gender differences and attitudes towards use of computer.

This study also revealed that male and female pupils exposed to differentiated instruction did not differ significantly in mathematics achievements in basic schools in FCT, Abuja, Nigeria. This is so because both male and female pupils were taught under same conditions and during primary school age, there is little or no difference in the metabolism of the pupils due to gender. Odicta (2017) believe that the differentiated instruction group has "high" mathematics achievement and "developing" critical thinking skills; while the non-differentiated group has an "average" posttest mathematics achievement and "developed" critical thinking skills.

Contradicting some of the positive outcomes observed in this study, it is essential to consider

the potential limitations and alternative perspectives. Despite the reported improvement in pupils' achievement, there may be varying opinions on the long-term sustainability and transferability of differentiated instruction methods across diverse educational settings. Research by Johnson (2018) suggests that the effectiveness of differentiated instruction may be influenced by factors such as teacher training, classroom resources, and student backgrounds.

Additionally, while the study highlights significant gender differences in the interest and attitude of pupils towards mathematics, it's crucial to acknowledge the existing debates on the impact of teacher gender on academic outcomes. Contrary to the findings in this study, a meta-analysis conducted by Smith and Brown (2019) proposes that teacher gender might not be a consistent predictor of student achievement, and other factors such as teaching style and interpersonal skills play a significant role.

Furthermore, the positive influence of differentiated instruction on post-test mean interest and attitude in mathematics aligns with existing literature. A meta-analysis by Tomlinson (2014) emphasizes that the adaptability of differentiated instruction allows educators to address diverse learning needs and foster a positive learning environment.

In exploring the potential reasons for the observed gender differences in interest and attitude, it is essential to consider socio-cultural aspects that may impact students' perceptions of mathematics based on gender. A study by Martin et al. (2016) highlights the role of societal expectations and stereotypes in shaping students' attitudes towards subjects like mathematics.

Conclusion

The researcher concluded that there was improvement in the pupil's achievement after they were taught with differentiated instruction, male and female pupils did not differ significantly in achievement in mathematics after they are taught with differentiated instruction.

Recommendations

Teachers should continue to use different teaching methods that will improve pupils' attitudes rather than sticking to the traditional areas. Differentiated Instruction should be encouraged in teaching mathematics to pupils at the basic level.

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