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EFFECT OF CUISENAIRE RODS' APPROACH ON STUDENTS' INTEREST IN DECIMAL FRACTIONS IN JUNIOR SECONDARY SCHOOL, MAKURDI METROPOLIS.

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ABSTRACT

This study explored the effectiveness of Cuisenaire Rods' approach in arousing students' interest in decimal fractions. Two research questions were posed and three hypotheses were formulated to guide the study. A sample of 200 JS3 students from a randomly selected schools in Makurdi Metropolis of Benue State, served as subjects for the study. A Mathematics Interest Inventory on Decimal Fraction (MIIDF) developed by the researcher and validated by three experts with a reliability coefficient of 0.72 using K-$R_{(21),}$ was used as a research instrument for data collection. Mean, Standard deviation and two way analysis of covariance (ANCOVA) were used for analyzing the data. The results revealed that Cuisenaire Rods' approach was very effective in facilitating students' interest in decimal fractions ($F_{1,\ 199\ =}$163.077, $p<0.05$. That though male students benefited more than their female counterparts this benefit was not significant ($F_{1,199}$=1.483;$p>0.05$). There was significant interaction effect between method and gender ($F_{1,199}$=20.848; $p<0.05$). It was recommended among others that teachers of mathematics should adopt this approach in teaching mathematics in Junior secondary to facilitate students' interest and hence improve performance in mathematics.

KEY WORDS: Cuisenaire Rods, Students' interest in mathematics, manipulative activities, hands-on, concrete materials, decimal fractions.

INTRODUCTION

Mathematics is a service subject. It serves as the language, lubricant and tool in the process of developing science and creating technology. Any nation that neglects its mathematics cannot develop socially, economically, politically, scientifically and technologically. Based on this then Nigeria has made mathematics a compulsory subject in primary and secondary levels of education.

Despite the importance placed on mathematics, students' performance in mathematics has not been impressive over a past decade now (Obodo, 2004; Azuka, 2006). This deplorable condition of students' performance in mathematics examinations in this country is nothing to write home about. This situation is caused by several factors. Such factors according to Obodo (2004) and Odili (2006) include the abstractness of mathematics concepts, students' lack of interest in the subject and the way these concepts are presented to the students. Ukeje (2000) and Amazigo (2000) observed that mathematics is one of the most poorly taught, widely hated and abysmally understood subject among secondary school students in Nigeria. The Chief Examiners of WAEC have recommended the use of practical and concrete representations in teaching abstract concepts for better understanding and to arouse and facilitate students' interest and understanding resulting in better performance in mathematics (WAEC, 2007). Use of manipulative and representation is strongly advocated too by National Council of Teachers of mathematics – NCTM (2000). This study was necessitated in attempt to reply to the call of the above bodies. The researcher wants to use Cuisenaire Rods' Approach (CRA), which uses concrete, physical, observable and touchable objects to teach abstract concepts in mathematics. Cuisenaire rods are concrete physical objects which one can see, touch and manipulate in the class. Using Cuisenaire Rods approach to teach concepts in

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mathematics goes a long way to fulfill this recommendation by both WAEC and NCTM. This study then uses the Cuisenaire rods' approach to teach fractions to selected JS3 students in Makurdi Metropolis, Benue State.

Cuisenaire Rods' Approach to Mathematics Teaching:

Cuisenaire Rods were invented over 75years ago by George Cuisenaire – a Belgian mathematics teacher. He invented this unique system for helping students grasp abstract concepts in mathematics using colored cardboard strips of varying lengths called Cuisenaire rods. A pack of Cuisenaire rods consists of 74 rectangular rods in 10cm different lengths and 10 different colors. Each color corresponds to a different length. The content of the pack is thus: 22 white rods of 1cm each, 12 red rods of 2cm each, 10 light green rods of 3cm each, 6 purple rods of 4cm each, 4 yellow rods of 5cm each, 4 dark red rods of 6cm each, 4 black rods of 7cm each, 4 brown rods of 8cm each, 4 blue rods of 9cm each and 4 orange rods of 10cm each. These rods could be used as manipulative and symbolic concrete representations in teaching any concept in mathematics. Learners explore whole numbers, fractions, measurements, ratio, area, perimeter, symmetry, congruency, 3-dimensional geometry and functions etc using Cuisenaire rods (Thompson, 1994).

Cuisenaire rod approach (CRA) is a hands-on and minds- on manipulative activities filed approach for teaching abstract concepts in mathematics and sciences. It is a valuable educational tool for modeling relationships between what is taught in school and what exists at home, making connection between what is taught in school and their everyday life activities [Elia, Gagatsis & Demetrico; 2007].This is because this approach prepares students to meet daily standards with daily critical thinking activities. It prepares young children for school success in mathematics and meets the needs of every age group. It is full of innovative, standard and systematic interesting activities as well as ready – made tools that engage learners in the teaching and learning of mathematics in the classroom. It enables every student to work independently and in a group on meaningful mathematics contents while the teacher provides individual attention to other students (Van de Walle, 2007).Because Cuisenaire rods are ready-made tools, its approach, minimizes preparation and set up time both for the teacher and the students. It meets state and national standard as a concrete objects for teaching and learning. Students are engaged practicing essential concepts and skills in mathematics using this approach. It is appealing to broad range of interests and provides a "way in" to literacy through the content areas for every student in the class.

Cuisenaire rods' approach (CRA) is an easy to follow approach that offers activities to help students' master estimation and measurement. It promotes successful learning experiences that made it change mathematics education forever (Elia, et al 2007). It provides a real world context for cross curriculum reading. It is teacher friendly, student friendly as well as learner - and activity centered which sparks off students' interest in mathematics. This approach helps to develop key skills such as classification, critical thinking, problem solving, logical mathematical and spatial reasoning (Rule & Hilagan, 2006). It involves a lot of cooperatively and collaboratively working group (Butler, Miller, Crelan, Babbitt & Pierce, 2003).It allows for pre and post exposure to mathematical concepts which leads to a better overall comprehension supported with in-dept students' group discussion.

In a Cuisenaire rods' approach (CRA) classroom, the lesson begins with students shared into groups of threes or fours and a park of Cuisenaire rods given to each group. They are acquainted with the content of the park and what each color stands for. The teacher explains to the students what is expected from them, the objectives of the lesson and the type of cooperation needed. Here the teacher is only a resource person, an instructor and a guide to the experiment. It begins with the exploration of the learner's immediate environment and ends with the application of the lesson learnt to his immediate environment. Learner's past experience forms the basis of the teaching and learning. This means relating classroom activities to learner's life experience which enables him to see the relationship between what is taught in school and what is done at home thereby facilitating transfer of learning (Case, Cates, Smith, & Jackson, 2003). The real experiment with the rods depending on the topic in question with the teacher giving the instructions and the directions to be carried out by the learners follows. There is group discussions among members of the groups, inter group discussion, teacher student discussion which leads to effective interaction and daily assignments. This discussion forum warms up and sparks off

students' interest from the beginning to the end of each lesson. As the learners progress from one manipulative representation to the other, they learn and understand important mathematics concepts and develop abstract logical thinking. Endless opportunities are presented to investigate and reinforce key mathematics topics and ask questions freely without fear. This lesson involves cooperation, collaboration and individual works (Moyer, 2001).

This approach helps the learner to learn from others and be able to ask questions when he does not understand or when in a fix as opposed in today's mathematics classroom. It requires minimal preparation for the teacher. The fun involved in this approach makes students absorbed in the varieties of the activities (Butler et al, 2003). Studies carried out on this approach revealed that students taught using this approach rapidly acquired problem solving skills, maintained these skills over a two- month period and transferred these skills to a paper and pencil problem solving format (Case, et al, 2003). This approach makes teachers very creative, inquisitive, open and devoted to teaching and learning since they have to improvise the materials to be used thereby fulfilling the purpose of teacher education (FRN, 2004). This classroom game like activities creates fun and gives immediate result and feedback to both students and teachers which fuels their energy and arouses their interest to engage in more activities (Fox, 1976). It as well sustains the interest of learners for a longer period because it is learning by doing which is at the heart of mathematics knowledge (Weissglass, 1977). The newness, practical, result – oriented and explorative nature excites the learners so much that they begin to emulate the work of their teachers resulting in frequent practice at home even without being given home exercise in and outside the classroom. Those who learnt, begin to teach the younger ones. With this, long life education in mathematics is encouraged in mathematics. This is so because, when what is learnt in school is taken home and taught in turn to those at home, who neither know the origin nor are they part of the class, the learning becomes continuous, moving from hand to hand. This type of handover and teaching continues from generation to generation thereby encouraging continuous learning. The use of concrete material for practical takes away the abstractness seen in mathematics concepts (NCTM, 2000). Its problem solving ability leads to discovery which is aesthetic. This method has no gender differentiation and suits every age by its game-like activities (Weissglass, 1977).

Since abysmal performance and lack of interest in mathematics by students over a decade have been attributed to be caused by the non inspiring method of teaching used by the mathematics teachers, this study wants to see whether the use of CRA as innovative strategy, will arouse JS3 students' interest in decimal fraction and hence facilitate their performance particularly in decimal fraction and in mathematics at large.

This study explains the significance of using a good teaching method especially the one involving the use of concrete objects in exposing mathematical concepts to students in a practical way. CRA has this unique significance too of helping teachers appreciate and learn the essence of using concrete materials for teaching and significance of teaching for understanding thereby making learning permanent. The use of concrete materials (physical objects) helps to sensitize the senses for better understanding thereby taking away the abstractness often expressed in mathematics teaching and learning.

The main purpose of this study is to determine the effectiveness of using Cuisenaire Rods approach to arouse students' interest and hence improve their performance in decimal fractions. Specifically the study sought to determine the

a) effect of Cuisenaire Rods approach on students' interest in decimal fractions
b) differential effect of Cuisenaire rods approach (CRA) on interest of male and female students in decimal fractions
c) interaction effect of Cuisenaire rods approach (CRA) and gender on students' interest in decimal fractions.

Research Questions

The following research questions were posed to guide the study:

1. What is the difference in the mean interest scores of students taught decimal fraction using Cuisenaire Rods' approach (CRA) and those taught using conventional approach?
2. What is the difference in the mean interest scores of male and female students taught decimal fractions using Cuisenaire rods' approach (CRA)?

Research Hypotheses

The following null hypotheses were formulated and tested at p<.05 level of significance for the study:

$Ho_{1;}$ There is no significant difference in the mean interest scores between students taught decimal fractions using Cuisenaire rods' approach (CRA)and those taught the same topic using Conventional method.

Ho_2: There is no significant difference in the mean interest scores between male and female students taught decimal fractions using Cuisenaire Rods' approach (CRA).

Ho_3: There is no significant interaction effect between method and gender measured by students mean interest scores in decimal fraction.

METHODS

The quasi – experimental Pretest posttest non equivalent control design was considered appropriate for this study. This was because it was not possible to have complete randomization of the subjects so as not to disorganize the schools. Intact classes were used for this study. The schools used had 50 students in each class. The sample consisted of 200 JS 3 students (100 males and 100 females) from 2 single sex secondary schools purposely selected for this study from Makurdi Metropolis of Benue State. Single sex schools were used to avoid pollination of ideas during interaction of students in the same school. This is purposive since the researcher placed the condition on her own because of the type of result she is expecting

From the schools selected, two intact classes were randomly drawn by balloting. Treatment and Control groups were randomly assigned to the different intact classes too by balloting. The experimental group was taught decimal fractions using Cuisenaire rods' approach (CRA) while the Control group was taught the same topic using Conventional approach. The treatment and Control groups each comprise of two intact classes. Equal classes were used to avoid bias.

The research instrument by name Mathematics Interest Inventory on Decimal Fraction (MIIDF) used for this study was constructed by the researcher. This instrument consists of 22 items to measure students' interest in decimal fractions. This instrument was subjected to face and content validation by three experts from mathematics education and again three from measurement and evaluation. The reliability coefficient of 0.72 was obtained using Kuder-Richardson ($K\text{-}R_{(21)}$) for the study.

The researcher used regular school mathematics teachers of each school as research assistant. A training program was organized for these research assistants. They were exposed to all the essential steps of using Cuisenaire Rods' approach (CRA) and Conventional approach as applicable. All necessary instructional materials for the study were made available for the study. MIIDF was administered to each group as Pretest and collected before the commencement of the lesson by the teacher. The experimental group was taught decimal fractions using Cuisenaire Rods' approach (CRA) while the Control group was taught the same topic using Conventional approach. The normal 40minutes duration was observed per lesson supervised by the researcher.

This study lasted for three weeks. At the end of the three weeks of twelve periods, the teacher administered the Post test to both groups. The scripts were collected, scored and used for analysis both pretest and posttest. Mean and standard deviation were used for answering research questions and two way analysis of covariance (ANCOVA) was used for testing the null hypotheses.

RESULTS

The findings of the study which are relevant in answering the two research questions and the hypotheses are contained in Tables 1& 2 below

Table 1: Mean Interest Scores and Standard Deviation of MIIDF

Group	Gender	Mean	Standard Deviation	N
Experimental	male	69.28	10.16	50
	Female	60.84	8.98	50
	Total	65.06	10.44	100
Control	male	43.88	11.25	50
	Female	49.06	9.96	50
	Total	46.47	10.89	100

Table 1, revealed that the experimental mean interest post score is 65.06 while that of Control group is 46.47 resulting in the mean difference interest score of 18.59. This answers the research question 1.

In response to research question 2, Table 1 also revealed that in the treatment group, male students had the mean interest score of 69.28 while the female students had the mean interest score of 60.84 resulting in the mean difference of 8.44 post interest scores.

Table 2: ANCOVA Results of Post MIIDF

Source of Variation	Sum of squares	DF	Mean Square	F	Sig.	Decision
Corrected Model	19839.424	4	4959.856	48.425	.000	S
Intercept	153380.744	1	153380.744	1497.519	.000	S
Pretest	108.369	1	108.369	1. 058	.305	NS
Methods	16702.827	1	16702.827	163.077	.000	S
Gender	151.938	1	151.938	1.483	.225	NS
Gender*Methods	2135.342	1	2135.342	20.848	.000	S
Error	19972.531	195	102.422			
Total	661759.000	200				
Corrected Value	39811.955	199				

NS means not significant. S means significant $p<0.05$

Table 2 shows that this difference observed between the mean interest scores of the treatment and the Control groups in Table 1, is statistically significant in favor of the experimental group ($F_{1,99}$=163.077; $p<0.05$). Hence the null hypothesis of no significant difference is rejected.

The difference observed in the mean interest scores of male and female in table 1 is not statistically significant as seen in table 2 ($F_{1,199}$= 1.483; $p>0.05$). Then the null hypothesis of no significant difference is not rejected.

There was as well interaction effect between method and gender (see Table 2) and this interaction was found to be statistically significant. We therefore reject the null hypothesis of no significant interaction between method and gender in students' interest in mathematics ($F_{1, 199 =}$ 20.848, $p<0.05$).

DISCUSSION

This study shows that the students in the experimental group performed better in the posttest (mean 65.06, SD 10.44) than those in the Control group (Mean 46.47, SD 10.89). The null hypothesis one was rejected; showing significant difference in the mean interest score ($F_{1,199}$ = 163.077, $p<0.05$) of the students taught decimal fractions using Cuisenaire Rods' approach (CRA). This shows that Cuisenaire Rods' approach is effective in facilitating and arousing interest of students in decimal fractions. This finding agrees with the works of Fox (1976), and Van de Walle (20007) and confirmed the recommendation of NCTM (2000) that use of manipulative that involves hands- and minds- on activities, have positive effect in arousing students' interest especially in mathematics.

Thus, with the use of Cuisenaire Rods' approach (CRA), students will definitely understand and do better in the knowledge of mathematical concepts particularly decimal fractions resulting in better performance as found in this study.

It is also found that there was difference in mean interest score in favor of the males (mean 60.84, SD 8.98) but this difference is not significant using Cuisenaire rods' approach (CRA) ($F_{1,99}$=1.483, p,0.05). This finding is in line with the studies carried out by Wessglass (1997) and Elia et al (2007), who reported that gender is not a factor in interest of students when manipulative is used in teaching. This is because using Cuisenaire Rods in teaching benefited both sexes thereby taking away the difference created by making mathematics either a masculine or feminine subject. The higher mean interest score (65.06) obtained using Cuisenaire Rods' approach (CRA) was as a result of Students being practically and actively involved in the meaningful activities of this approach. These activities were interesting, involving, practical, homely, full of fun, meaningfulness game like, organized and product – oriented. The environment too was free and student – friendly resulting in facilitated interest in decimal fraction using Cuisenaire Rods' approach (CRA) (Case, et al, 2003). Interaction between the learners not minding the sex, was encouraging and recommended.

CONCLUSION AND RECOMMENDATIONS

Based on the findings of this study, the following recommendations are made:

Teachers are advised to use Manipulative especially Cuisenaire Rods' approach (CRA) in teaching abstract concepts in mathematics since it is students' friendly, activity oriented, arouses students' interest and facilitates higher understanding that results in higher performance,

Teachers should try to improvise these manipulative and encourage students to do the same for use as resource materials that will give enough understanding of mathematics concepts, facts and principles.

Schools should provide these essential manipulative as resource materials and make them available to teachers to use for teaching for better and effective meaningful teaching and learning in mathematics.

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