Advanced Journal of Education Research ISSN 2053-2105 Vol. 2 (2), pp. 019-022, December, 2015..
Available online at www.advancedscholarsjournals.org © Advanced Scholars Journals

Full length Research paper

Effect of Cuisenaire Rods' loom on some Nigeria primary pupils' attainment in decimal fractions

James Karume* Andy MoMoh**

[1]Statistics Education , Department of Mathematics Bauchi State University, Bauchi, State, Nigeria.
[2]Applied Mathematics Education , Department of Mathematics Bauchi State University, Bauchi, State, Nigeria.

Accepted 20 October, 2015

This study determined the result of Cuisenaire Rods' loom on some Nigeria primary pupils' attainment in decimal fractions. Three hypotheses guided the study. A total of 200 Primary six pupils (that is, 6th grade) from randomly selected schools in Bauchi metropolis of Bauchi State of Nigeria served as the sample for the study. A Mathematics Attainment Test on Decimal Fractions (MATDF) developed by the researchers and validated by three experts with a reliability coefficient of 0.89 using K-R $_{21,}$ was used for data collection. Two way Analysis of Covariance was used for analyzing the data. The results revealed that there was a significant difference between pupils taught fractions using Cuisenaire Rods' loom and those taught fractions using conventional loom with Cuisenaire rod loom being more facilitative ($F_{1, 199} = 12.231$; $p < 0.05$). Secondly, there was no significant difference between male and female pupils taught using Cuisenaire Rods loom ($F_{1, 199} = 3.453$; $p > .05$). However, there was no significant interaction effect of method and gender on achievement ($F_{1, 199} = 1.424$; $p > 0.05$) It was therefore recommended among others that teachers of mathematics should adopt Cuisenaire Rods loom in teaching mathematics in primary schools in the study area to ensure hands-on-activities and thereby contributing to enhanced understanding.

Key words: Cuisenaire Rods loom, pupils' attainment in mathematics, manipulative activities, hands-on, concrete materials, abstract materials, decimal fractions.

INTRODUCTION

Mathematics is an essential subject for scientific and technological development of any nation. This is to say that no nation can grow scientifically and technologically above her mathematics status. With this understanding, Nigeria made mathematics a compulsory subject in her primary and secondary levels of education. Notwithstanding, over the past decade, students' performance in mathematics has not been impressive (Agashi, 2003; Obodo, 2004; Azuka, 2006; Uloko and Imoko, 2007). The deplorable condition of students' performance in mathematics examinations can be observed clearly from the summary of students' performance as expressed by WAEC for a period of seven years (2000 – 2006) in Table 1 reveals the ugly trend in students' performance in mathematics in Nigeria between 2000 and 2006. For instance, for a period of seven years, the highest percentage credit pass is below 40% (that is, 39.92%). This situation could be attributed to several factors. Such factors include the abstractness of mathematical concepts, the way these concepts are presented to the students and poor foundation, among others. As a way out, the Chief Examiners of WAEC recommended the use of practical and concrete representations in teaching abstract concepts for better understanding in mathematics (WAEC, 2007). Similarly, Achor (2003) recommended that abstract or formal concepts in physics should first be downloaded in concrete terms to allow for understanding among learners as majority are concrete operators. The fact that mathematics and physics share so many things in common presupposes that mathematics could be facing similar problem as in physics. This appears corroborated by the fact that the use of manipulation and representation is strongly advocated by the National Council of Teachers of Mathematics (NCTM, 2000) as well as Agashi (2003). This entails the use of concrete, physical, observable and touchable objects like Cuisenaire Rods to teach abstract concepts. However, no

*Corresponding author E-mail: james2Karume@yahoo.com.

matter how the learners are taught with concrete materials, if the foundation is faulty every efforts made could amount to waste (Agashi, 2003; Uloko and Usman, 2007).

There is therefore a need to have a tryout of an approach like the use of Cuisenaire Rods that have been used in many other countries and have consistently proved to be efficacious (Thompson, 1994; Case, et al., 2003; Van de Walle, 2007). With the intention to establish a firm foundation in mathematics in Nigeria, the primary school could be the right place to introduce such instruc-tional material. Further, primary six appears like a transition class where those preparing to move to secondary school prepare seriously for entrance exami-nation of which mathematics is a major component. Secondly, the knowledge of mathematics acquired at this level (through a fairly retentive approach) could go a long way to influence their performances in other levels of education. Thirdly, fractions seem to be the center component of all the in depth knowledge in mathematics (that may appear abstract to primary pupils) especially decimal fractions and, a little attention given to it at that level could be a stitch in time.

Cuisenaire Rods are concrete, physical objects which one can see, touch and manipulate in the class. Although this loom has been in existence for well over 7 decades now, the seemingly unpopular nature of it in developing nations like Nigeria and the recent emphases on hands-on-activities necessitates a revisit. It is specu-lated in this paper that using Cuisenaire Rods loom to teach concepts in mathematics and specifically decimal fractions could go a long way to fulfill the expec-tations of all to bring about improved performance. It is equally speculated that the expected improved performance may be gender biased. And until there are empirical evidences, these remain at the level of speculations particularly in Nigeria. This study therefore used both the Cuisenaire rods' and conventional methods to teach fractions to some primary six pupils in Bauchi Metropolis of Bauchi State of Nigeria. Primary school is particularly chosen because it is considered foundational to other levels of mathematics teaching and learning. Secondly, primary six is focused because it is a transition class and as such a lot is taught to them in the area of fractions which appear to dominate most of the entrance examinations into secondary schools. Thirdly, the mathe-matics curriculum for primary schools has a lot in terms of content on decimal fractions.

The teaching method adopted is often questioned seriously when there is poor performance. As a follow up, the Chief Examiners of WAEC/NECO (2007) and NCTM (2000) have recommended the use of manipulative approaches as an effective approach for improving per-formance in mathematics. Other methods of teaching mathematics have been used variously based on previous research but could not give the expected result. Some of the methods include ethno-mathematics approach, computer assisted instruction, problem solving approach, and so on (Sani and Ochepa, 2002; Uloko and Usman, 2007; Uloko and Imoko, 2007). In pursuance of this, the study is poised to determine the effect of using Cuisenaire Rods approach on pupils' achievement in decimal fractions. Specifically the study sought to determine the;

i.) Effect of Cuisenaire Rods approach on pupils' achievement in decimal fractions.

ii.) Differential effect of Cuisenaire rods approach on achievement of male and female pupils in decimal fractions.

iii.) Interaction effect of Cuisenaire rods approach and gender on pupils' achievement in decimal fractions.

Cuisenaire Rods and mathematics teaching

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

Cuisenaire Rods' loom 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 betw-een what is taught in school and what exists at home, making connection between what is taught in school and their everyday life activities (Elia et al., 2007). 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. This approach helps to develop key skills such as classification, critical thinking, problem solving, and logical, mathematical and spatial reasoning (Rule and Hllagan, 2006). It involves a lot of cooperatively and collaboratively working group (Butler et al., 2003).

In a Cuisenaire rods' approach classroom, the lesson begins with students shared into groups of threes or fours

Table 1. Analysis of Students' Performance in WAEC from 2000 – 2006.

Year	No. of Entry	% Pass/Credit	% Failure
2000	643,371	32.81	67.19
2001	1023,102	36.55	63.45
2002	1078,901	34.50	65.50
2003	939,506	36.91	63.09
2004	844,525	34.52	65.48
2005	943,371	35.55	64.45
2006	1045,406	39.92	60.08

Source: WAEC Office.

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 et al., 2003). 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 learner 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 under-stand or when in a fix as opposed in today's mathematics classroom. It requires minimal preparation by 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). 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. 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 favours both sexes thereby encouraging male and female students (Weissglass, 1977).

Hypotheses

Three null hypotheses were formulated and tested at $p < 0.05$ level of significance in the study:

Ho_1: There is no significant difference in the mean achievement scores between pupils taught decimal fractions using Cuisenaire Rods' loom and those taught the same topic using Conventional method.

Ho_2: There is no significant difference in the mean achievement scores between male and female pupils taught decimal fractions using Cuisenaire Rods' approach.

Ho_3: Teaching method does not interact significantly with gender to influence pupils' achievement in decimal fractions.

METHODS

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 as that could disorganize the schools. Intact classes were used for this study. The schools used had 50 students in each class. The sample consisted of 200 primary six pupils (100 males and 100 females) from 2 coeducational primary schools sampled for this study.

From each of the schools selected, two intact classes of 50 pupils each were randomly drawn by balloting. Treatment and Control groups were randomly assigned to the different schools too by balloting. The experimental group was taught decimal fractions using Cuisenaire Rods' loom while the control group was taught the same

Table 2. ANCOVA Results of Post MATDE.

Source of variation	Sum of squares	DF	Mean square	F	Sig.	Decision
Corrected Model	149, 25.687	4	3731.422	4.369	0.002	S
Intercept	163220.578	1	163220.578	191.124	0.000	S
Pretest	42.712	1	42.712	0.050	0.823	NS
Methods	10445.044	1	10445.044	12.231	0.001	S
Gender	2948.670	1	2948.670	3.453	0.065	NS
Gender*Methods	1216.483	1	1216.483	1.424	0.584	NS
Error	166530.708	195	854.004			
Total	847199.000	200				
Corrected Value	181456.395	199				

NS means not significant. S means significant

topic using Conventional approach.

The treatment and Control groups each comprise of two intact classes of the same size. The research instrument by name Mathematics Attainment Test on Decimal Fraction (MATDF) used for this study was con-structed by the researchers. This instrument consists of 22-multiple choice items with four options to measure pupils' performance in decimal fractions. The items in this MATDF evaluated the lower and higher cognitive processes with ratio of 60:40 as recommended by the National Policy (FRN, 2004).

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 0.89 was obtained using Kuder-Richardson (K-R 21) using a test retest method on a sample of 30 pupils.

The researcher used regular mathematics teachers of each school as research assistants. A training programme was organized for these research assistants. They were exposed to all the essential steps of using Cuisenaire Rods' loom and Conven-tional approach as applicable. All necessary instructional materials for the study were made available for the study. MATDF 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' loom while the Control group was taught the same topic using Conventional approach. The normal 40 min 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, marked and scored over hundred for both pretest and posttest. Two way analysis of covariance was used to analyse the data.

RESULTS

The results for testing hypotheses 1, 2 and 3 are contained in Table 2.

Table 2 shows that the difference observed between the mean achievement scores of the treatment and the Control groups is statistically significant in favour of the experimental group ($F_{1, 199} = 12.231$; $p < 0.05$).

Hence the null hypothesis of no significance is rejected.

This difference observed in the mean achievement scores of male and female is not statistically significant as seen in Table 2 ($F_{1, 199} = 3.453$; $p > 0.05$).

Then the

null hypothesis of non significant difference is retained. Interaction effect of method and gender (Table 2) on achievement was not significant ($F_{1, 199} = 1.424$; $p > 0.05$). The third null hypothesis was again retained.

DISCUSSION

This study shows that the pupils in the experimental group had higher mean gain achievement in decimal fractions than those in the control group. This shows that there was a significant difference between the mean achievement score of the pupils taught decimal fractions using Cuisenaire Rods' loom and those taught using the conventional method. By implication and since the mean achievement of the experimental group is far higher than that of the control group, Cuisenaire Rods loom is more facilitative in the achievement of pupils in decimal fractions. This finding agrees with the works of Case et al. (2003), Rule and Hllagan (2006) and con-firmed the recommendation of NCTM (2000) that use of manipulative that involves hands-on and minds-on activities have positive effect on improving pupils' acade-mic achievement especially in mathematics. Thus, with the use of Cuisenaire Rods' loom which is a kind of manipulative, pupils demonstrated better knowledge of mathematical concepts particularly decimal fractions as found in this study.

It is also found that there is no significant difference between the achievement scores of male and female pupils taught decimal fractions using Cuisenaire Rods'

loom. This finding is in line with the study carried out by Fox (1976) that gender has no significant effect on performance of pupils when manipulative is used in teaching. This is because using Cuisenaire Rods in teaching benefits both sexes thereby taking away the difference created by making mathematics a masculine or male subject. It however contradicts the finding of Bloke and Imoko (2007) that a significant difference exists in the achievement of male and female students taught mathematics using ethno-mathematics approach. Though both studies are in the area of mathematics, the fact that the methods used in teaching and the levels of subject used differ could explain the difference in the findings.

The significant effect observed between the experimental and control could be attributed to learners being practically and actively involved in the meaningful activities of this approach. These activities were interesting, involving, practical, homely, and full of fun, meaningful, organized and product-oriented. The environment too was free and learner-friendly resulting in effectiveness in achievement of the approach (Case et al., 2003).

CONCLUSION AND RECOMMENDATIONS

This study concludes that the use of Cuisenaire Rods in teaching decimal fractions in mathematics is more facilitative in enhancing pupils' achievement than Conventional method of teaching. Secondly, that gender is not an influencing factor in the achievement of pupils taught decimal fractions using Cuisenaire Rods. Thirdly, that teaching method and gender do not interact to influence achievement of pupils in decimal fractions.

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

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

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

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

REFERENCES

Achor EE (2003).Cognitive correlates of physics achievement of some Nigeria senior secondary students. J. Sci. Teach. Assoc. Niger., 38(1-2): 10-15.

Agashi PP (2003). Attainment of Van Hiele levels of mental develop-ment in geometry by JuniorSecondary School Students. J. Natl. Assoc. Sci., Humanit. Educ. Res. 1(1): 25-31.

Azuka BF (2006). Effective ways of teaching mathematics in secondary schools. A paper presented in the Workshop on "the Improvement of the teaching and learning of the mathematical sciences in secondary schools "organized by NMC7 PTDF Joint Project.

Butler FM, Miller SP, Crelan K, Babbitt B, Pierce T (2003). Learn. Disabil., Res. Pract., 18 (2): 99 -111.

Case M, Cates D, Smith M, Jackson C (2003). Effect of manipulative instruction on solving area and perimeter problems on students with learning disabilities. Learn. Disabil. Res. Pract., 18 (2): 112 -120.

Elia L, Gagatsis A, Demetrico A (2007). The effects of different Modes of Representation on the solution of one- step additive problems

Federal Republic of Nigeria (2004). National policy on education. Yaba, Lagos: NERDC Press.

Fox LH (1976). Sex difference in mathematical precocity-bridging the gap In Kenty DP (Ed) Intellectual talent: Research and development. Baltimore: The John Hopkns Press.

Moyer PS (2001). Are we having fun yet? How teachers use manipula-tive to teach mathematics. Edward studies in mathematics: Int. J. 87(2): 175-197.

National Council of Teachers of Mathematics, (2000). Principles and standards for school mathematics. Reston,V.A: NCTM

Obodo GC (2004).Principles and practice of mathematics education in Nigeria; Enugu, Floxtone Press

Rule AC, HIlagan JE (2006). Pre- service elementary teachers' use: Drawing and make-sets of materials to explain multiplication and division of fractions. ETA Production

Sani SO, Ochepa IA (2002). Effect of practical discussion outside the classroom on students' performance in mathematics. Abacus, 27(10): 45-48.

Thompson PW (1994). Concrete materials and teaching for mathema-tical understanding. Centre for research in mathematics and science education. Arithmetic Teacher, 41(9): 556-558.

Uloko ES, Imoko BI (2007). Effect of Ethno-mathematics teaching approach and gender on students' achievement in Locus. J. Natl. Assoc. Sci., Humanit. Educ. Res., 5(2): 31-36.

Uloko ES, Usman KO (2007). Effect Ethno-mathematics teaching approach on students' achievement and interest. Uniagric J. Res. Sci. Media, 1(1): 22-28.

WAEC (20007). West African Secondary school Certificate Examina-tion, May/June. Nigeria Statistics of Entries and results. Lagos: WAEC Publishers.

Weissglass J (1977). Mathematics for elementary teaching: A small-group laboratory approach. Am. Math. Mon., 84(5): 377- 362