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Using Cuisenaire Rods to Overcome the Problem of Pupils' Inability to Solve Addition of Proper Fractions in Some Selected Schools in the Krachi East Municipality

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Abstract

Excellent performance in the study of mathematics in basic and high schools today is a key global development priority. However, despite high-level educational policy efforts and financial investments by government and other policy bodies, the idea still remains an elusive goal.

The researchers examine the use of Cuisenaire rod in teaching addition of fractions as an effort to teach and make learning interesting for pupils.

This research adopted a multi-case study approach, documenting the impact of the Cuisenaire rod and some other dynamic approaches in teaching and learning mathematics in our schools. Data was gathered through observation, structured interviews and tests. It was found that the use of the Cuisenaire rod, some other teaching methods, as well as, dynamism of teachers and pupils is a key enabling factor in ensuring excellent performance in mathematics in our schools today.

The use of Cuisenaire rod demonstrated a great potential to make a real difference to achievement in mathematics by teaching addition of fractions. However, current formulations of policies and development overlook the key contribution of dynamic structured teaching approaches: this is vital to ensuring long term success.

This research paper explains why and how this new knowledge can be used to inform future policy and initiatives on the ground.

Keywords: Cuisenaire rod, Fraction, Performance

Introduction

Many studies have documented that the topic of fractions is a difficult topic in Mathematics (e.g. Charalambous& Pitta-Pantazzi, 2007; Hasemann, 1981; Streefland, 1991). Many pupils find it difficult to learn fractions because there are many complicated rules in the operation of fractions compared to those in the natural numbers. According to Howard (1991), and Young-Loveridge (2007), a common mistake by pupils in solving an addition of fractions is the procedure "top + top over bottom + bottom". They argued that, pupils do this incorrect procedure since they think fraction is two different whole numbers.

Another factor that contributes to this difficulty is that, fractions have many interpretations; which are a fraction as a part-whole relation, a measure, a ratio, a quotient and an operator (Charalambous& Pitta-Pantazzi, 2007; Young-Loveridge, 2007).Charalambouset al. (2010), stated that, focusing merely on one interpretation of fraction is a factor that can impede pupils' learning of fraction.

In addition, some studies have shown that a conventional instruction on fractions that provide a set of algorithms does not promote a meaningful learning for most pupils (Lamon, 2001). As has been stated by Freudental (1991), that mathematics is a human activity, so in learning mathematics, pupils should actively experience and

construct their understanding. Regarding to this, Cuisenaire rods are very important since it can promote pupils' understanding of a concept and the relationship between concepts. Moreover, Cuisenaire rods can support pupils in constructing the mental representations of the concept been taught.

It is amazing during the researchers visit to some schools; find out that pupils of Dambai Holy Rosary R.C Junior High School Form Two (2), could not execute the addition of proper fractions. This problem has compelled the researcher to undertake this study and use appropriate interventions to solve the problem under study.

This problem is due to the fact that, many teachers still use the conventional method of teaching mathematics and place more emphasis on the rules and algorithms than the pupils understanding. Moreover, pupils live in a predominantly farming community and therefore do not have time to practice what they have learnt in school.

Statement of the Problem

The problem under study is inability of pupils to add proper fractions in Dambai Holy Rosary R.C Junior High School Form Two (2). In the researchersregular visit to the school that isDambai Holy Rosary R.C Junior High School form Two (2), the class teacher taught addition of fractions as a topic in mathematics. It was also observed that, the teacher did not use appropriate teaching learning materials during the lesson, making it difficult for the pupils to understand the concept of addition of fractions. Going through available literature, there has been a little research on the use of Cuisenaire rods as an intervention to add proper fractions.

The researcher therefore decided to use the available resource (Cuisenaire rod), to guide pupils to overcome their difficulties in adding proper fractions

Purpose of the Study

The purpose of the study was to help pupils to improve upon the addition of proper fractions using Cuisenaire rods.

Research Questions

1. What is the impact of Cuisenaire rods on the learning motivation of JHS 2 pupils of Dambai Holy Rosary R.C Junior High School?
2. To what extent can Cuisenaire rods improve JHS 2 pupils of Dambai Holy Rosary R.C JHS understanding of addition of proper fractions?

Research Design

The research design used was Action research. The study population includes all pupils of Dambai Holy Rosary R.C Junior High School. The entire student population was 364, consisting of 181 boys and 183 girls. As a result of time and resource constraint, the research was based in JHS 1 which has a total student population of 94, comprising 34 boys and 60 girls. The sampling technique used in selecting respondents for this study was simple random sampling. The researchers used observation, structured interview and tests to gather information about the problem under study.

Theory and Calculations

Observation

The researchers critically observed pupils to collect background information about the problem. During the observation, the researcher keenly examined pupils' exercise books to determine their level of understanding of Mathematics concepts that were taught them.

Structured Interview

The researchers administered structured interview questionnaires to respondents who provided information about the problem under study. The questionnaire collected data on respondents' demographic characteristics, factors influencing performance in Mathematics and respondents' perceptions on the effectiveness of Cuisenaire rods for teaching fractions. It is important to point out that the structured interview questionnaires were administered after the intervention. The responses of the pupils were recorded and analyzed using the Statistical Package for the Social Science (SPSS).

Tests

Tests were also used to collect data. Two main types of tests were conducted: pre-test and post-test. The pre-test was conducted during the pre-intervention stage to measure the pupils' level of understanding when it comes to the addition of proper fractions. The post-test was conducted after the intervention to ascertain the effectiveness of the intervention.

Data Collection Procedure

The data was collected from different sources using the research instruments named above so as to get vivid information for the research work. The procedure was in three stages namely pre-intervention, intervention and post-intervention.

Pre- Intervention

During the researcher's attachment at Dambai Holy Rosary R.C JHS, he observed the pupils and asked them why they faced difficulties answering Mathematics questions and participating in class discussions during Mathematics' lessons. The researcher used four weeks to carry out the pre-intervention activities. The researcher used the first and second weeks to critically look through pupils' exercise books to see the marks they scored in Mathematics.

During the second week, the researcher conducted pre-test on the addition of proper fractions with unlike denominators and recorded the scores against the serial number of respondents. In the same week, the researcher designed the questionnaires which were vetted by the supervisor. The questionnaires were also piloted on fifteen JHS 2 pupils to check the validity and reliability of the instrument before proceeding to collect data.

Intervention

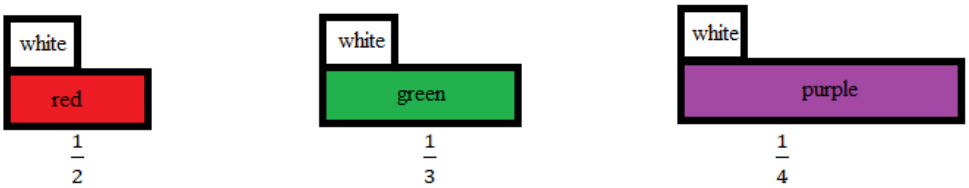
Intervention refers to the situation in which someone becomes involved in an issue in order to influence what happens. What the researchers wanted to influence was pupils' understanding of the addition of proper fractions using the Cuisenaire rods. The intervention process lasted for three weeks.

Week One

The researchers used this week to introduce the concept of fractions to respondents. The definition of fractions, types of fraction, parts of fractions and the importance of learning fractions were taught as part of the introductory lesson.

Week Two

During this week, the researcher taught respondents how to model fractions with Cuisenaire rods. Fractions such as$\frac{1}{2}$, $\frac{1}{3}$,$\frac{1}{4}$ and many more were modelled using Cuisenaire rods. Pupils were given Cuisenaire rods and guided to model each fraction with each color rod representing the numerator and the denominator respectively.

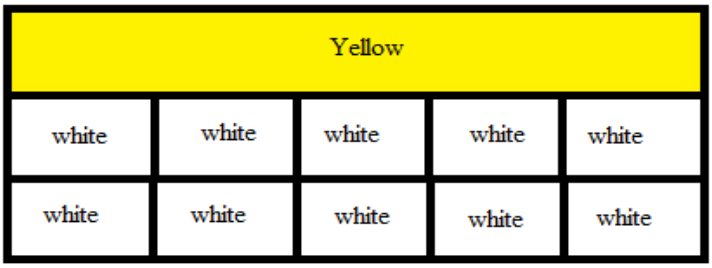


After these activities, pupils were given more complex fractions which most of them successfully used the Cuisenaire rods to model. They were then given class exercises to use Cuisenaire rods to solve and they did that perfectly.

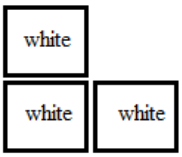
Week Three and Four

Weeks three and four were used to teach respondents addition of proper fractions using Cuisenaire rods. The researcher represented the addition of these fractions; $\frac{1}{5}$and$\frac{2}{5}$. The researcher guide pupils to choose a yellow rod as a unit rod; this can be split into five. He now fined a rod whose length will be the same as the unit whole. It was therefore noticed that five white rods joined end to end will be of equal length as the unit whole. For $\frac{1}{5}$, he made pupils choose one white rod out of five white rods and also guide pupils to choose two white rods out of five othe

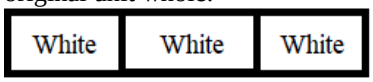
r white rods as For $\frac{1}{5}, \frac{2}{5}$ as illustrated below;



The researcher further guided pupils choose 1 white rod as $\frac{1}{5}$ and in the second train of white rods, chose 2 white rods as$\frac{2}{5}$.



Further, the researcher made pupils join all the white rods end to end to signify the addition and compare to the original unit whole.



It was observed that, there were 3 white rods and comparing with the unit whole, we can write as$\frac{3}{5}$. And so, the pupils realized that, $\frac{1}{5} + \frac{2}{5} = \frac{3}{5}$

The researcher repeated this process involving the addition of many proper fractions with unlike denominators using Cuisenaire rods to respondents throughout the third and fourth week of intervention. Exercises were given and many of the pupils performed well. The researcher also solved all the questions after the exercises using the Cuisenaire rod.

Post – Intervention

During the post-intervention stage, the researcher evaluated the effectiveness of the Cuisenaire rods for teaching addition of proper fractions. A test was conducted for the respondents after the intervention was successfully completed to determine the extent to which the Cuisenaire rods has improved the understanding of respondents in the addition of proper fractions. Pupils were scored over hundred (100), marks and the mark obtained by each student was recorded against his or her serial number. Questionnaires were also administered to respondents to find out the factors that influenced performance in Mathematics. The questionnaires also sought to investigate how the Cuisenaire rods have improved pupils' interest in learning Mathematics as a whole.

Results and Discussion

Cuisenaire Rods and Addition of Fractions

The main purpose of this study was to use Cuisenaire rods to improve pupils' understanding in the addition of proper fractions. To have a clearer picture of the real impact of Cuisenaire rods, two tests were conducted. The pre-test served as a baseline survey to measure the situation on the ground before the intervention was ministered. After which a post test was conducted to measure the impact of Cuisenaire rods.

Test Results

The results of the pre-test and post-test are displayed in table 1and 2 respectively. Judging from the tables, it is clear that pupils performed poorly in the pre-test. About 33% of pupils scored zero in the pre-test. Only 3% of pupils were able to score from 50 marks and above. Overall, the mean mark obtained by pupils in the pre-test was 7. 28 marks.

Table 1.Pre-Test Results

x	fx
33	0
1	2
1	5
7	56
1	10
2	40
1	24
1	25
1	50
1	64
1	88
50	**364**

$\Pi = \frac{\sum fx}{\sum f} = \frac{364}{50} = \underline{\mathbf{7.28}}$

In the post-test, pupils performed well. Only 3% of pupils scored below 50 marks. The rest scored above 50 marks. The mean mark obtained by pupils in the post-test was 61.18 marks as compared to 7.28 marks obtained in the pre-test. This is an indication that there has been an improvement in the understanding of pupils of the concept of fractions. This improvement is attributed to the use of Cuisenaire rods to assist in the teaching and learning process. Even though the use of the Cuisenaire rods has had some impact on pupils' understanding, we cannot conclude that this was absolutely due to the use of Cuisenaire rods. There is therefore the need for us to perform the t-test of significance to ascertain the statistical significance of this impact.

Table 2.Post -Test Results

Marks (x)	Frequency (f)	fx
40	1	40
46	1	46
49	1	49
50	5	250
52	2	104
53	1	53
54	3	162
55	2	110
56	5	280
57	4	228
58	1	58
59	1	59
60	5	300
62	1	62
64	2	128
66	4	264
67	1	67
68	1	68
70	2	140
76	1	76
78	1	78
80	1	80
87	2	174
90	1	90
93	1	93
Total	**50**	**3059**

$\Pi = \frac{\sum fx}{\sum f} = \frac{3059}{50} = \underline{\underline{\mathbf{61.18}}}$

The t-test of Significance

In table 3.below, the mean mark obtained in the post test and pre-test were 61.18 and 7.28 respectively. The difference between the two means was 53.9 marks. The study is 95% confident that the difference between the two means would always fall between 48.11 and 59.68 marks if the study is repeated 100 times. For the difference (53.9), to be statistically significant, the probability value should be less than 0.05 level of significance. Since the probability value of 0.000 is far lesser than 0.05, we concluded that the difference between the post test and pre-test result is statistically significant. Therefore, the use of Cuisenaire rods had significantly improved pupils' understanding of the addition of fractions with unlike denominators.

Table 3. T-test of Significance

Variable	Mean	Standard Error	Standard Deviation	95% Confidence	Interval
Post-Test	61.18	1.63	11.53	57.90	64.45
Pre- Test	7.28	2.41	17.06	2.43	12.13
Difference	**53.9**	**2.91**		**48.1**	**52.32**

t = 18.50 (Pr> 0.000), ***

Discussion of Findings

The discussion of findings shall be put in themes in accordance with the research objectives.

To What Extent Can Cuisenaire Rods Enhance the Learning Motivation of Pupils In Mathematics?

Motivation was measured using three items: willingness to learn mathematic, participation in class discussions and punctuality in mathematic classes. It was clear that the use of Cuisenaire rods to teach Mathematics had greatly impacted on pupils' willingness to learn Mathematics. This was because the intervention was very practical and made the addition of fractions easy for pupils to understand. This broke the jinx that Mathematics is very difficult. It was therefore not surprising that pupils expressed willingness to continue to learn Mathematics regardless of the topic.

Participation in class discussions among pupils after the intervention also increased tremendously. Before the intervention, only 40% of pupils participated actively in class discussions. After the intervention, however, the number of active participants in class discussions increased from 40% to 70%. Again, we see the efficacy of using Cuisenaire rods to teach pupilsaddition of fractions. This did not only made pupils play active parts in the concept of fractions but also translated into participating actively in other topics in Mathematics.

Another area in which the impact of the use of Cuisenaire rod was felt was punctuality in class exercises. Prior to the intervention, the majority (80%), of pupils were not punctual at Mathematics classes. This was as a result of the method with which teachers taught pupils Mathematics. After using Cuisenaire rods, punctuality increased from 20% to 60%. By implication, non-punctual population reduced by half (from 80% to 40%). This change in behavior affirms the research of Haas (2002), Ali et al. (2010), and Eshun (2002), that the teaching method adopted to teach a particular topic could affect achievement in Mathematics.

To What Extent Can Cuisenaire Rods Assist Pupils To Solve Addition Of Fractions?

The main objective of this study was to help improve the understanding of pupils in addition of proper fractions. To be able to measure the effectiveness of the Cuisenaire rod, pre-test and post-test were conducted. In the pre-test, pupils scored an average mark of 7.28. The average mark obtained by pupils in the post-test was 61.18. This gives us a fair idea that there had been improvement in pupils understanding of addition of proper fractions after Cuisenaire rod was used to teach. But to avoid making any hasty conclusions, we subjected these results to a significant test that gives us confidence to draw conclusions. At 0.05 significance level or 95% confidence level,

we concluded that the use of Cuisenaire rods had had a significant impact of pupils' understanding of the concept of addition of fractions.

The use of Cuisenaire rods impacted positively on pupils learning motivations in the areas of willingness to learn, participation in class discussions and punctuality in Mathematics classes. The intervention was also found to have had a highly significant impact on pupils' understanding of addition of proper fractions.

Cuisenaire rods and Pupils' Understanding of Addition of Fractions

The researcher conducted a pre-test to determine the situation on the ground before administering the intervention. After which a post-test was conducted to ascertain the effectiveness of the intervention. The average mark obtained by pupils in the pre-test was 7.28 as against 61.18 in the post-test. The difference between these two means is 53.9 points to the fact that the intervention was effective. In order not to make hasty conclusions, the pre-test and post-test data were subjected to a significant test using the Student's t-test. The test results show that the difference between the two means was statistically significant. Therefore we conclude that the use of Cuisenaire rods to teach had a highly significant impact on the understanding of pupils in multiplying fractions with unlike denominators.

The study shows that there are many females than males in JHS 2 of Dambai Holy Rosary R.C. Junior High School. Most pupils in JHS 2 are 13, 14 and 15 years of age. It was also evident that parents' educational attainments were very low and as a result were unable to help their children with home works. It was found that demographic characteristics such as age, sex and parents' educational attainment did not influence performance in mathematics. Rather study time, motivation from parents, teaching methods, availability of teaching materials and pupils' perception about mathematics were the factors which influenced performance in Mathematic. With the use of Cuisenaire rods to teach, pupils learning motivations were significantly improved. Also, the use of Cuisenaire rods significantly boosted pupils' understanding of addition of fractions with different denominators.

Conclusion

The purpose of the study was to help pupils to improve upon the addition of proper fractions using Cuisenaire rods. It was concluded that the use of Cuisenaire rods helped improve pupils understanding of addition of fractions with different denominators.

Recommendation

1. The study demonstrates how an effective teaching method could boost the motivation of pupils in learning. The use of Cuisenaire rods improved pupils' willingness to learn made them active in class discussions and made them punctual in mathematics lessons. Therefore, teachers should select teaching methods that is constructivist in nature. This approach involves the learners in the teaching and learning processes and makes teaching very practical. Even when teaching and learning materials are absent, teachers should try as much as possible to improvise. It is the abstract teaching of mathematics that often fuels negative attitude of pupils towards the subject.

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