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Full Length Research

Investigating pupils' strategies on mathematics achievement among private and public basic schools in the Chorkor Circuit of Accra Metropolis

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ABSTRACT: The purpose of this study was to investigate the mathematics achievement and strategies of private and public schools in the Chorkor circuit of Accra Metropolis. The survey research design was used for the study. The population used for the study was 617 and a sample of 242 was selected which comprised of 160 from public schools and 82 from private schools. Three research questions were formulated to guide the study. The instrument used for the study was a self-made Mathematics Achievement Test (MAT) on the topic "sets". The test items were validated by the researcher's supervisor and experts. The reliability of the instrument was determined using Pearson Product Moment Correlation Statistics. This was used to obtain the reliability index of the instrument and was found to be 0.85. Mean, standard deviation, T-test and percentages were used to answer research questions. The findings of the study showed that the students in private schools performed higher than those in public schools. The study recommended that private school authorities and heads of public basic schools encourage mathematics teachers to emphasize on concepts, facts and principles during mathematics instruction on the various topics of the curriculum since it forms part of students' Subject Matter Knowledge (SMK).

Keywords: Chorkor, mathematics achievement, private school, public schools.

INTRODUCTION

Mathematics is a compulsory and very important subject taken by learners in the primary and secondary levels of education. It involves the manipulation of algorithms and axioms in mathematical investigations (Wachira, 2016). The teaching syllabus on mathematics at the basic level by the Ghana Education Service noted that the goal of mathematics is to enhance the acquisition of numerical and logical skills by learners and assist them to think in a logical, accurate and precise way. The significance of mathematics is necessary to all learners that is why learners' achievement in the subject was not taken for granted by researchers.

Mathematics Achievement refers to the accomplishment of a given task that is measured against predetermined standards of accuracy, completeness, cost, and speed (Kayode, 2016). The mathematics achievement of basic schools means the rate of students passing grades in the national examinations (students' overall examination scores), it also measures the total performance (scores) of pupils on the mathematics achievement test.

However, Iddi (2016) argued that students' scores in mathematics (Achievement) from both private and public basic schools have been poor, though few had impressive mathematics performance in the Basic Education Certificate Examination (BECE). This poor achievement from private and public basic schools in the Basic Education Certificate Examination could be apportioned to the fact that students have very low subject matter

knowledge (SMK) on mathematics and also do not use appropriate strategies for solving mathematics problems. Arthur *et al*. (2017) stressed the weakness of pupils' performance, adding that most basic school pupils lack basic strategies and concepts for solving mathematical problems.

Amuzu *et al.* (2017) argued that there were a lot of factors that may account for the differences in the mathematics achievement of private and public schools in Ghana. However, it is necessary to conduct further study into the issue of private and public-school achievement in mathematics, between private and public basic schools in the Chorkor Circuit of the Accra metropolis with an emphasis on which school performed better than the other in the mathematics achievement test and why.

Statement of the problem

Mathematics is made compulsory at the primary and secondary levels of education besides admission into higher institutions and professional institutions. In Ghana, students' poor performance in mathematics has been attributed to factors such as poor teaching methods, unqualified and inexperienced teachers and inadequate or low subject matter knowledge of mathematics (Bonsu, 2016). These factors have negative effects on performance hence the low mathematics achievement of students in both public and private basic schools in Ghana (Maamin *et al*., 2020).

However, private schools are now gaining more ground in terms of mathematics performance or achievement in both internal and external examinations. Pupils in private basic schools have mostly untrained teachers but better supervision makes them perform better than the pupils from public schools in mathematics. Consequently, more of the pupils from private basic schools gain admission into good secondary schools than their counterparts from public schools since good grades in mathematics, science and English language serve as the basis for admission (Bonsu, 2016). Awan and Zia (2015) pointed out that public basic schools performed poorly on mathematics achievement, and this is a very serious problem since a higher percentage of them gain admission into public secondary schools with such weak grades.

The consequences of this poor performance of public basic school pupils in mathematics was the reason to carry out a study on private and public-school mathematics achievement and why the differences in mathematics achievement exist. In an effort to systematically work on issues contributing to the differences in mathematics achievement between private and public basic school pupils, the Chorkor Circuit of the Accra Metropolis was chosen as the focus of this study. The findings of the study are intended to solve the issue of mathematics achievement between private and public basic school pupils with emphasis on which school performed better than the other and why.

Research objectives

In line with the study, the following research objectives were raised to guide the study:

1. To identify the strategy used by public school pupils to solve mathematics achievement test.
2. To identify the strategy used by private school pupils to solve mathematics achievement test.
3. To compare the difference in students' mathematics achievement between public and private basic schools' pupils.

Research questions

In line with the study, the following research questions were raised in this study:

1. What strategies did public school pupils used to solve mathematics achievement test?
2. What strategies did private school pupils used to solve mathematics achievement test?
3. Are there any differences in mathematics achievement between public and private basic school pupils in the Chorkor Circuit of the Accra Metropolis?

Research hypotheses

To answer research question 3, the researcher formulated the following null and alternative hypothesis:

H_0: There is no significant difference in students' mathematics achievement between private and public basic school pupils.
H_1: There is significant difference in students' mathematics achievement between private and public basic school pupils.

Significance of the study

The study adds to the existing body of knowledge on the reasons why private schools perform better than public basic schools in mathematics. The study will also attract further studies on issues related to the performance between private and public basic schools and other levels of education. The empirical results from the field will help as an immediate indicator of the situation in private and public basic schools which can be directly used to address the situation in case there is a need to do so and utilize the recommendations to further improve mathematics in basic education in Ghana.

LITERATURE REVIEW

The concept of school mathematics achievement

Ong'uti *et al*. (2019) asserted that school mathematics achievement refers to the accomplishment of a given task that is measured against predetermined standards of accuracy, completeness, cost, and speed. In this study, school mathematics achievement refers to pupils' performance and how well they meet the standards set by the responsible examination body. The mathematics achievement of basic schools means the rate of students passing grades in the national examinations (students' overall examination scores) on mathematics achievement tests.

Acharya (2017) stressed that mathematics achievement is the rate at which pupils score in a standardized examination to determine their progression to the next level. Higher mathematics achievement depends on the linkage between new mathematical concepts and how to apply these concepts in any mathematical situation. However, lack of linkage between new mathematical concepts and previously learned mathematics structure are the main cause of lower scores on mathematics achievement.

Ayebale *et al*. (2020) hold a different view that mathematics achievement of pupils declines as they show negative attitudes such as anxiety and fear towards the subject. Students' attitudes toward mathematics have notably been recognised as one of the determinants of mathematics achievement. Mathematics attitude correlates to students' personal mathematics achievement. They emphasised that the majority of students held negative attitudes toward mathematics. This was also similar to the study of Cofie (2020) that students' attitude and perception toward mathematics has been a factor that is known to influence students' achievement in mathematics.

Also, Recber *et al.* (2018) analysed pupils' attitudes and how they influence academic achievement in mathematics. The result revealed that pupils had positive attitudes toward mathematics and many believe that the subject is worthwhile to study and necessary for their future but performed badly in the subject due to their lack of understanding of basic concepts in mathematics.

Subject matter knowledge of pupils on mathematics achievement

Lacaba *et al*. (2018) defined subject matter knowledge as concepts, facts and principles of mathematics with regard to the various topics in the school curriculum. Students having an in-depth knowledge of the various topics in the school mathematics curriculum can enhance mathematics achievement. Pupils' performance (achievement) in mathematics depends on their understanding of mathematical concepts, facts and principles on mathematics tests. Yeh *et al*. (2019) also stressed that not only do pupils' understanding of concepts, principles and facts enhance mathematics achievement but also the application of these concepts, facts and principles in any mathematical problem is very necessary and improves achievement.

Ansah *et al.* (2020) emphasized that the use of appropriate strategies and methods on mathematics tests has a positive influence on performance. However, using inappropriate strategies and methods on mathematics problems by pupils has a negative influence on mathematics achievement and hence low performance. For a very good mathematics achievement, there must be a connection between mathematical concepts, facts, principles and their application in any mathematical problem, a disconnection may result in low achievement.

The teaching and learning of mathematics essentially help the students in acquiring essential mathematics knowledge, skills, interests and attitudes. Academic achievement has become an index of a child's future in this highly competitive world. Academic achievement has been one of the most important goals of the educational process. Achievement encompasses student ability and performance. Mathematics achievement has an influence on the learners' practical use of mathematical subject knowledge (Bonsu, 2016).

Public schools and private schools

The issue of private versus public education has been of great significance to developed and developing countries. The study of the dynamics that occur between public and private schools is attracting educational researchers around the world. The concept of private and public may also vary depending on different education systems; and, for comparison, it should be defined in a broad sense (Hendajany, 2016).

Ng'ang'a (2019) defined public schools as those which are owned managed and financed by the state. Public schools have a uniform curriculum at the district level, and sometimes even state wide. However, public schools may suffer from funding issues that private schools do not have. On the other hand, according to Bonsu (2016), private schools are those owned, managed, and financed by parents, associations, businesses, non-profit organizations, or religious institutions.

In the Ghanaian context, the public basic schools include government and community schools, both of which receive full government funding for recurrent costs (some of which are defrayed through the collection of school fees). The only difference between them pertains to the funding of school construction costs: for government schools construction costs are borne by the government while for private schools they are borne by individuals (Kamal *et al*., 2017).

The private sector in Ghana comprises of a great diversity of schools, whose unifying feature is that they all depend almost exclusively on school fees and private contributions to defray both recurrent and capital costs. Although the overwhelming majority of private schools are created by religious and other community organizations, there are now a lot of new schools that are operated by individuals or groups of individuals for profit (Mills and Mereku, 2016). For the purpose of this study, public basic schools are schools that are owned by the government and private schools are schools owned by individuals.

Mathematics performance between private and public basic school

Kalagbor (2016) compared the performance of pupils in private and public school students' achievement. The finding revealed that there is a significant difference between public and private school students in mathematics. They also emphasized that s private schools' small class sizes and school environments enhance mathematics performance compared to public schools. Teachers tend to devote more time to teaching students. In public schools, there is a poor attitude towards teaching (Telu, 2016).

The performance of pupils in private schools especially in mathematics has been found to be persistently higher than that of pupils in public schools (Azigwe *et al.* 2016). The secret is greater commitment, motivation, and supervision of teachers (Abin *et al.,* 2020). They further stressed that private schools performed better in mathematics than public schools in both internal and external examinations. In the Ghanaian educational system, private schools performed better in mathematics than public schools. There was a paradigmatic shift whereby private basic schools in Ghana began to perform better in mathematics achievement than public schools (Atuahene *et al*., 2019).

METHODOLOGY

In this study, the researcher employed a survey research design. Surveys are designed to obtain information concerning the current status of phenomena. They are directed towards the nature of the situation as it exists at the time of the study and they focus on determining the status of a defined population with respect to certain variables. It is concerned with conditions or relationships that exist, opinions that are held, processes that are going on, effects that are evident, or trends that are developing. A survey describes data and characteristics of the population or phenomenon being studied. The survey answers questions like who, what, when, where, and how.

The population targeted in this study was pupils from Junior High School Form Three (JHS3) in both private and public basic schools at Chorkor in the Accra Metropolis. In all, there were ten (10) private and five (5) public schools in the Chorkor Circuit of the Accra Metropolis. A total of six hundred and seventeen (617) pupils from both private and public schools. Five private schools were selected with the five public schools in the circuit. A sample size of two hundred and forty- two (242) students from both private and public basic schools were selected for the study. Eighty-two (82) pupils and one hundred and sixty (160) were selected from both private and public schools respectively.

The study used two types of sampling procedures which were purposive and simple random sampling. Purposive sampling means that respondents were chosen on the basis of their knowledge of the information desired. To avoid bias when choosing pupils as part of the sample, pieces of paper labelled “Yes” or “No” were put in a box, and the pupils were allowed to pick a piece of paper from the box. Those who picked papers written ‘Yes’ were involved in the sample. This was done because in the random sampling procedure, each member of the population in the group had an equal chance of being selected. The five private schools were purposively selected because some of the private schools do not have Junior High School and also Junior High School Form Three Class (JHS3), therefore purposive sampling technique was necessary for the selection of the five private schools for the study. All five public schools were selected since they all have Junior High Schools and also Junior High Schools Form Three Class (JHS3). Hence, the study constitutes five private and five public schools in the Chorkor Circuit of the Accra Metropolis.

The study also adopted a proportional representation for the selection of samples from each school and this was done before choosing the sample from each class. Proportional representation was very necessary for this study, since the schools in the Chorkor Circuit of the Accra Metropolis do not have the same number of pupils in each class. There was the need to take a proportional representation of the various schools in the metropolis depending on the number of pupils in each class.

$$\text{Sample from Each School} = \frac{\text{No. of students in Class x Sample (for the study)}}{\text{Total Population}}$$

The selected pupils from the various classes (that is from private and public schools) by proportional representation, constitute the sample of the study which is two hundred and forty-two (242). Out of the 242 students which form the sample of the study, eighty-two (82) were from private schools and one hundred and sixty (160) from public schools.

RESULTS

Research question 1: What strategies did public school pupils use to solve mathematics achievement test?

The item analysis on the mathematics achievement test of public-school pupils was meant to answer research question one. This was meant to answer how public-school pupils attempted or solved mathematics achievement tests.

The test item basically is on set where pupils were supposed to list a subset of a universal set and also a universal set. Pupils were supposed to describe sets *P, Q,* and *R* as the subset of the universal set and also the intersection of sets. This question was quite a challenge to public school pupils as most of them listed elements that do not belong to the main universal set. The following strategies were used by the pupils:

1. Defining elements in the Universal set U.
2. Description of elements of set P, Q and R.
3. Intersection of sets.

As in Table 1, sixteen pupils (n=16, 10%) listed the correct element in subsets P, Q, and R which was quite insignificant as compared to the number of public-school pupils. Fifty of the students (n=50, 31%) listed the subset set wrongly, that is they could not define exactly the members in the universal set. Thirty–five pupils (n=35, 22%) define elements in sets P, Q, and R wrongly. Fifty-nine pupils (n=59, 37%) failed to attempt the question and this was very significant.

In Table 2, only fifteen pupils (15, 9%) could state intersections and relationships of set correctly, fifty-one (51, 32%) had intersection and relationships wrongly, thirty-five pupils (35, 22%) were unable to write intersections and relationship of set of P, Q and R, while fifty-nine (n=59, 37%) failed to attempt the question.

Research question 2: What strategies did private school pupils use to solve mathematics achievement test?

The item analysis on mathematics achievement tests of private school pupils was meant to answer research question two. This was meant to answer how private school pupils attempted or solved mathematics achievement test.

The test item basically is on set, this question was quite a challenge to private school pupils as some of them listed elements that do not belong to the universal set. Pupils were supposed to describe sets P, Q and R as the subset of the universal set and also the intersection of sets. The pupils used the following strategies:

Table 1. The subset of the universal set for public schools.

Theme	Freq.	%
Subset correctly listed	16	10
Subset wrongly listed	50	31
Wrong definition of set	35	22
Failed to attempt question	59	37
Total	160	100

Source: Field data 2018.

Table 2. Intersection and relationship of set for public schools.

Theme	Freq.	%
Correct intersections and relationship of set	15	9
Wrong intersections and relationships of set	51	32
Unable to write intersections and relationship	35	22
Failed to attempt question	59	37
Total	160	100

Source: Field data 2018.

Table 3. The subset of the universal set for private schools.

Theme	Freq.	%
Subset correctly listed	29	35
Subset wrongly listed	19	23
Wrong definition of set	12	15
Failed to attempt question	22	27
Total	82	100

Source: Field data 2018.

Table 4. Intersection and relationship of set for private schools.

Theme	Freq.	%
Correct intersections and relationship of set	27	33
Wrong intersections and relationships of set	21	26
Unable to write intersections and relationship	12	15
Failed to attempt question	22	26
Total	82	100

1. Defining elements in the Universal set U.
2. Description of elements of set P, Q and R.
3. Intersection of sets.

As in Table 3, Twenty-nine pupils (n=29, 35%) could state correctly the subset. Nineteen pupils (n=19, 23%) stated wrongly the subset. A proportion of twelve pupils define the set wrongly (n=12, 15%) and twenty-two pupils failed to attempt the question (22, 27%).

Table 5. An independent t–test to answer research three.

School type	Mean	SD	N	Sig (2- tailed)
Private	28.6826	19.66867	82	0.000
Public	12.3601	12.75242	160	0.000

Table 6. Levine's test for equality of variance.

Levine's test for equality of variance	t-test for equality means				
	F	Sig	T	Df	Sig (2 tailed)
Equal variances assumed	44.546	0.000	10.704	451	0.000
Equal variances not assumed			9.610	248.765	0.000

In Table 4, only twenty-seven pupils (n=27, 33%) could state the correct intersections and relationship of set P, Q, and R. Twenty-one (n=21, 26%) pupils could not state the correct intersections and relationship of set P, Q, and R. Twelve pupils (n=12, 15%) were unable to write the intersections and relationship of set P, Q, and R. And twenty–two (22, 26%) failed to attempt questions.

Research hypothesis: There is no significant difference in students' mathematics achievement between public and private basic school pupils

To answer research question three, the individual marks obtained from both private and public schools on the mathematics achievement test were coded and keyed into a statistical package for the social scientist program (SPSS) for analysis. An independent t-test in Table 5 shows that there was a significant difference in the performance between public and private basic pupils' mathematics achievement in the Chokor Circuit of the Accra Metropolis.

As in Table 5, private schools' mathematics performance was significantly higher (M=28.6826, SD= 19.66867) than public schools (M=12.3601, SD=12.75242). The mean scores and standard deviation of private schools was higher than public schools.

As in Table 5, there exists a statistically significant difference in the mean performance in the test of students between private and public schools. The observed probability significance is 0.00 < 0.05. This indicates that the performance between private and public schools was significant. It also implies that the null hypothesis is rejected. The study finally concludes that there was a significant difference in students' mathematics performance between private and public basic school pupils (Yogendra *et al*., 2016. Hence, private schools performed better on mathematics achievement tests than public schools.

In Table 6, the assumption of the equality of variance between the mean performance of private and public basic schools is significant under the Levine's test.

DISCUSSIONS

Discussion on public schools' mathematics achievement test

The first objective was to discuss the strategies used by public school pupils to solve mathematics achievement tests. The discussions were based on how public-school pupils solved each item, the techniques and strategies adopted. Public school pupils used four strategies for solving the item. The strategies were grouped under the following headings:

Defining elements in the universal set

The strategy or techniques of which element was to be included in the universal set was a challenge to public school pupils. The universal set $U = \{18 \leq x \leq 36\}$, posed a lot of challenges to pupils. The majority of public school pupils included elements which were not supposed to be part of the universal set U. The universal set only consists of elements from 18 to 36 inclusive. Pupils included elements 17 and 37 and others as part of the universal set U, however, few pupils were able to list exactly elements in the universal correctly. Pupils' definitions of elements in the universal set and their errors were shown below.

$$U = \{18,19,20,21,22,23,24,25,26,27,28,29,30,31,32,33,34,35,36\}$$

The group of pupils who listed the universal from 18 to 36 inclusive were correct. The reason been that the number eighteen with the sign "$18 \leq$ " will consider the numbers from eighteen (18) and above and also the number thirty-six with the sign " ≤ 36" will take numbers up to 36 which was the limit. The few pupils who defined the universal set from 18 to 36 as shown were correct. Another group of pupils also define the universal set as shown:

$$U = \{1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18 \ldots \ldots \ldots 36\}$$

This group of pupils deviated entirely from the definition of

the universal set because the elements from 1 to 17 were not part of the universal set. Also, this group of pupils had the intersection of set $P, Q\ and\ R$ wrongly since the set $P, Q, and\ R$ were subsets of the universal set U. The third group of pupils also define the universal set like this:

$U = \{17,18,19,20,21,22,23,24,25,26, \ldots\ldots\ldots\ldots\ldots\ldots\ldots 36\}$

This was also not correct for public school pupils since the number seventeen (17) was not part of the universal set. Finally, the last group of pupils also define the universal set as:

$U = \{17,18,19,20,21,22,23,24,25 \ldots\ldots\ldots\ldots\ldots..37\}$

This was also wrong because the numbers 17 and 37 by definition were not part of the universal set U.

Describing the elements of a set

The sets P, Q and R were subsets of the universal set U. The majority of public-school pupils ignore the concept of a subset. This was done by including elements in sets P, Q and R which were not in the universal set. Once the sets P, Q and R, were subsets of U it implies elements in sets P, Q and R should belong to the universal set. The majority of public-school pupils could not describe sets P, Q and R correctly. The elements in the universal sets were not in sets P, Q and R and vice versa. Pupils' descriptions of set $P, Q, and\ R$ are shown below:

The set $P = \{\ multiples\ of\ 3\}$. Two different descriptions for the set P by public school pupils as shown:

A. $P = \{3,6,9,12,15,18,21,24,27, \ldots\ldots\ldots..36\}$. The majority of public school pupils define set P as shown. Pupils were not able to identify the set P as a subset of the universal set, there were a lot of elements in set P which were not part of the universal set U. This description was wrong as the numbers in the universal set will only consider numbers that are multiples of 3 which are part of the universal set U. The concept here is not only the ability to list multiples of 3, however, the multiples of 3 should be part of the universal set U. Few public school pupils describe set P as:

B. $P = \{18, 21, 24, 27, 30, 33, 36\}$. This was correct since the numbers in set P are multiples of 3 from 18 to 36 within the universal set U.

The set $Q = \{factors\ of\ 72\}$. Two different descriptions for the set Q by public school pupils as shown:

A. $Q = \{1, 2, 3, 4, 6, 8, 9, 12, 18, 24, 36\}$. These were exactly factors of 72, however, most of the numbers in the set Q as listed by some groups of public school pupils were also not part of the universal set U, hence the majority who listed the set Q merely as factors of 72 had set Q wrong. Here pupils can list factors of 72, however, the answer was wrong because the set Q was not a subset of the universal set U. The second group of pupils describes set Q as:

B. $Q = \{18, 24, 36\}$. This was correct, the elements in set Q were factors of 72 and also within the universal set U. Only few public school pupils could describe the elements in set Q correctly.

The set $R = \{even\ numbers\ \}$. Two different descriptions for the set R by public school pupils as shown:

A. $R = \{\ 2, 4, 6, 8, 10, 12, 14, 16, 18, 20, \ldots\ldots\ldots\ldots.72\}$. These were exactly even numbers of 72, however, most of the elements in the set R as listed by some groups of public-school pupils were not part of the universal set U, hence, the majority who listed the set R merely as even numbers of 72 had set R wrong. Here pupils can list even numbers which were also multiples of 72, however, the answer was wrong because the set R was a subset of the universal set U.

B. $R = \{\ 18, 20, 22, 24, 26, 28, 30, 32, 34, 36\}$. Few public-school pupils describe the set R correctly. The elements in the set R are set of even numbers within the universal set U.

Intersection of set

The strategy of intersecting two sets was done appropriately by the majority of public school pupils. However, since sets P, Q, R, and the universal set U were not correctly defined by the majority, the intersections of sets $\mathrm{P} \cap \mathrm{Q}$, $\mathrm{Q} \cap \mathrm{R}$, and $\mathrm{P} \cap \mathrm{R}$ were also wrong by the majority of public school pupils.

Discussion on private schools' mathematics achievement test

The second objective was to discuss the strategy used by private school pupils to solve mathematics achievement test. The discussions were based on how private school pupils solved each item, the techniques and strategies adopted. Private school pupils used four strategies for solving the first item. The strategies were grouped under the following headings:

Defining elements in the universal set

The strategies or techniques of which element was to be included in the universal set was not a challenge for the

majority of private school pupils. The universal set $U = \{18 \leq x \leq 36\}$, did not pose much of a challenge to pupils. The majority of private school pupils define exactly the element in the universal set U. The universal set only consists of elements from 18 to 36 inclusive. Pupils' definitions of elements in the universal set and their errors were shown below.

$U = \{18,19,20,21,22,23,24,25,26,27,28,29,30,31,32,33,34,35,36\}$

The group of pupils who define the universal from 18 to 36 inclusive were correct. The reason been that the number eighteen with the sign "$18 \leq$" will consider the number eighteen (18) and above and also the number thirty-six (36) with the sign "≤ 36" will take numbers up to 36 which was the limit. The majority of private school pupils defined the universal set from 18 to 36 as shown were correct. Another group of pupils also defines the universal set as shown:

$U = \{1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18 \ldots\ldots\ldots 36\}$

This group of pupils deviated entirely from the definition of the universal set because the numbers from 1 to 17 were not part of the universal set. Also, this group of pupils had the intersection of set $P, Q \; and \; R$ wrongly since the set $P, Q, and \; R$ were subsets of the universal set U. Another group of pupils also define the universal set like this:

$U = \{17,18,19,20,21,22,23,24,25,26, \ldots\ldots\ldots\ldots\ldots\ldots\ldots 36\}$

This was also not correct for private school pupils since the number seventeen (17) was not part of the universal set. Finally, the last group of pupils also define the universal set as:

$U = \{17,18,19,20,21,22,23,24,25 \ldots\ldots\ldots\ldots\ldots..37\}$

This was also wrong because the nunumbers7 and 37 by definition were not part of the universal set U. The majority of private school pupils define the universal set correctly.

Describing the elements of a set

The sets P, Q and R were subsets of the universal set U. Few private school pupils ignore the concept of a subset. Private school pupils included elements in set P, Q, and R which were not in the universal set. Once the set P, Q, and R, were subsets of U it implies elements in set P, Q, and R should belong to the universal set. The majority of private school pupils could describe set P, Q, and R correctly. Pupils' descriptions of set $P, Q, and \; R$ are shown below:

The set $P = \{ multiples \; of \; 3\}$. Two different descriptions for the set P by private school pupils as shown:

A. $P = \{3,6,9,12,15,18,21,24,27, \ldots\ldots\ldots\ldots..36\}$. Few private school pupils define set P as shown. This description was wrong as the numbers in the universal set will only consider numbers that are multiples of 3 which are part of the universal set U. The concept here is not only the ability to list multiples of 3, however, the multiples of 3 should be part of the universal set U. Other private school pupils describe set P as:

B. $P = \{18, 21, 24, 27, 30, 33, 36\}$. This was correct since the numbers in set P are multiples of 3 from 18 to 36 within the universal set U.

The set $Q = \{factors \; of \; 72\}$, $Q = \{18, 24, 36\}$. This was correct, the numbers in set Q were factors of 72 and also within the universal set U. Only few private school pupils could not describe the elements in set Q correctly.

The set $R = \{even \; numbers \; \}$. Private school pupils describe the set R as:

R= {18, 20, 22, 24, 26, 28, 30, 32, 34, 36}. The majority of private school pupils describe the set R correctly. The elements in the set R are set of even numbers within the universal set U.

Intersection of set

The strategy of intersecting two sets was done appropriately by the majority of private school pupils. However, since few pupils could not define P, Q, R, and the universal set U, the intersections of sets $\mathrm{P} \cap \mathrm{Q}$, $\mathrm{Q} \cap \mathrm{R}$, $\mathrm{and} \; \mathrm{P} \cap \mathrm{R}$ were also wrong for some few private school pupils.

Discussion on mathematics achievement of private and public basic schools

The third objective was to compare the difference in students' mathematics performance between public and private basic schools' pupils. The study conducted at Chorkor in the Accra Metropolis revealed that private schools performed better than public schools in the Chorkor Circuit of the Accra Metropolis. The mean performance and standard deviation of private schools were (M=28.6826, SD=19.66867) and that of public schools was (M=12.3601, SD=12.75242). The observed probability significance is 0.00 < 0.05. This indicates that the performance between private and public school pupils was significant. This implies that the null hypothesis was rejected. The study finally concludes that there was a significant difference in students' mathematics performance between private and public basic school pupils in the Chorkor Circuit of Accra Metropolis. This

finding was consistent with previous literature that private schools performed better than public schools in mathematics achievement (Asomah *et al*., 2018).

The subject matter knowledge on mathematics achievement test was higher among private school pupils than their comparable public school pupils. The majority of public school pupils demonstrated weak or no subject matter on most of the mathematics achievement test, though few public-school pupils demonstrated strong subject matter knowledge. On the other hand, private school pupils demonstrated stronger subject knowledge in mathematics test than in public schools. This was one of the main reasons why private schools performed higher than public schools in the Chorkor Circuit of Accra Metropolis. The subject matter knowledge of pupils influences mathematics achievement (Ansah *et al*., 2020).

Conclusion

This study was aimed at comparing the performance of public and private basic schools performance at Chorkor in the Accra Metropolis. The study conducted at Chorkor in the Accra Metropolis revealed that private schools performed better than public schools. The mean performance and standard deviation of private schools were (M=28.6826, SD=19.66867) and that of public schools was (M=12.3601, SD=12.75242). The observed probability significance is 0.00 < 0.05. This indicates that the mean performance in private schools was greater than that of public schools. The implication was that the null hypothesis was rejected, and the study concluded that there was a significant difference in students' mathematics performance between private and public basic school pupils.

Recommendations

1. Both public and private basic school pupils lack basic concepts with regards to the topic "sets". Mathematics teachers must emphasize on concepts, especially on sets. Workshops must also be organized by personnel of the Ghana Education Service on topics that pose major challenges to students, the workshop must be directed toward the area where pupils had challenges in this study.
2. Most basic school pupils used wrong strategies or approaches to most of the achievement test. Those strategies may be learnt from textbooks that are not approved by the Ghana Education Service or from teachers who do not have in-depth knowledge on how (pedagogy) and what to teach (content). Private school authorities, heads of public schools and the Ghana Education Service must emphasize on the use of appropriate pedagogy in the classroom during teaching and learning. In-service training must also be organized periodically to update the knowledge and content level of both private and public basic school teachers.

CONFLICT OF INTEREST

The authors declare that they have no conflict of interest.

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