



Effect of High Pupil-Teacher Ratio on the Quality of Teaching and Learning Process of Mathematics in Selected Public Secondary Schools of Lusaka District, Zambia

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ABSTRACT

The purpose of the study was to assess the effect of pupil-teacher ratio on the quality of teaching and learning process of mathematics in selected public secondary schools of Lusaka district. Four specific research objectives which guided the study were; to determine the proportion of pupils in an average class in public secondary schools of Lusaka district; to establish the average pupil-teacher ratio in public secondary schools of Lusaka district; to determine the effects of class size on the teaching/learning process in public secondary schools of Lusaka district; and ascertain the strategies to improve or promote the quality of teaching/learning Mathematics in selected Public Secondary Schools of Lusaka District. The study employed descriptive survey design, and both qualitative and quantitative approaches were used to carry out the study. A multi-method approach involving interviews, questionnaires, focus group and document review was used to collect data. Participants and respondents were selected using random and purposive sampling procedures respectively. The study revealed that pupil-teacher ratio is high in most public secondary schools and has a negative effect on pupil academic performance in public secondary schools. From the findings, it is recommended that the government should employ competent teachers in order to increase the teaching force and encourage people with academic qualifications to join the teaching profession.

Keywords: Pupil –teacher ratio, Teaching process, Quality teaching, Learning process, Quality education, Public secondary schools, Zambia, Teaching Mathematics.

1. Introduction

Education is a process in which knowledge, skills and set of values are passed or imparted from one person to another. In the formal setting, where learning is done in schools, the success of education depends on the number of factors among which classroom environment is. One factor that affects classroom environment is class size. Class size refers to the number of pupils in any given class.¹ The influence of class size on pupil outcomes is an aspect of the learning environment which has been a subject of much debate among parents, politicians, teachers, teacher unions and educationists in many countries. The introduction of free education in many developing countries has led to a massive increase in the number of children enrolled in primary schools. Unfortunately, this increase in enrolment levels has not been accompanied by a proportional increase in resources such as teachers, classrooms and books. In Zambia, for example, large classes emerged immediately upon the introduction of Free Basic Education Policy in 2002.²

With the Free Basic Education Policy in place, enrolment levels in Basic and Secondary Schools tremendously went up while expansion and construction of the school infrastructure as well as deployment of teachers did not increase with the same proportion.³ The effects that this increased PTR had on the

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teaching-learning process raised debate among parents, teachers, teachers' unions, politicians and school administrators. Results from these debates were inconclusive. It is for this reason that this study was instituted so as to try and establish the effects that high pupil-teacher ratio had on the teaching-learning process in Public Secondary Schools of Lusaka District.

1.1 Statement of the Problem

Since the introduction of the Free Primary Education Policy in 2002, pupil-teacher ratio (PTR) in most public schools have gone up while expansion and construction of school infrastructure has not increased proportionately, resulting in large classes in most public schools. This increase in classes raised a country-wide debate about its effects on the teaching-learning process and quality of education being offered in Primary Schools. Few studies have investigated the effects of high PTR on teaching/learning process of Mathematics in public secondary schools in Zambia. It is against this background that this study sought to explore the effects of high PTR on the teaching/ learning process of Mathematics in Public Secondary Schools of Lusaka District.

1.2 Research objectives

The research objectives for this study were;

- (i) To determine the proportion of pupils in an average class in Public Secondary Schools of Lusaka District.
- (ii) To establish the average pupil-teacher ratio in public secondary schools of Lusaka District.
- (iii) To determine the effects of high pupil-teacher ratio on the teaching/learning process of mathematics in public secondary schools of Lusaka district.
- (iv) Ascertain the strategies to improve or promote the quality of teaching/learning mathematics in selected Public Secondary Schools of Lusaka District.

1.3 Research questions

- (i.) What is the proportion of pupils in an average class in public secondary schools of Lusaka district?
- (ii.) What is the average pupil-teacher ratio in public secondary schools of Lusaka district?
- (iii.) How does high pupil-teacher ratio affect the teaching/learning process of mathematics in public secondary schools of Lusaka district?
- (iv.) What strategies can schools use to improve or promote the quality of teaching and learning mathematics in the Selected Public Secondary Schools of Lusaka District?

1.4 Significance of the study

The findings of this study could be useful to policy makers in formulating policies suitable for enhancing quality teaching-learning process of mathematics in public secondary schools. The findings and recommendations could also attract the attention and possible action of educational officials through analysis and addressing of the issues raised. Finally, researchers may also find the study a useful addition to existing knowledge on the effects of high pupil-teacher ratio on the teaching and learning process in general.

2. Methodology

This study employed both qualitative and quantitative paradigms. The two methodological approaches were used to give the study an in-depth understanding that a single approach cannot attain. The study employed triangulation in data collection using unstructured interview schedules, observation checklist to elicit qualitative data and questionnaires for quantitative data. The target population included public secondary school head teachers, subject teachers and pupils in grade one and two. Pupils in grade one and two were targeted because these are the most overcrowded classes in both public and private schools. The numbers begins to reduce as pupils move to higher grades. The sample comprised 70 respondents, broken down as follows: 5 head teachers, 15 subject teachers (i.e. three from each sampled school) and 50 pupils (i.e. 10 from each school). Purposive and random sampling procedures were used to select the key informants (i.e. head teachers and subject teachers) and the pupils respectively. Based on the researcher's knowledge of the population, a judgment was made about the key informants who were selected to provide the best information to address the purpose of the research. A multi-method approach involving use of semi-structured interviews, Focus Group Discussions and classroom observation were used to collect data. Questionnaires were used to elicit data from head teachers on the number of learners in their classes. Semi-structured interviews were used to elicit data from head teachers and the subject teachers with regard to pupil-teacher ratio and its effects on the quality of the teaching and learning process of mathematics. Focus group discussions were used to elicit data from learners on how the big numbers affect them when it comes to learning Mathematics in class. The researcher also used classroom observation checklists to observe classroom practices and also studied the class registers in order to establish the number of learners per class in every sampled school. The advantage of using a multi-method approach in data collection is that, it eliminates bias or distortion of the researcher's picture of the particular reality he/she is investigating.⁴ Quantifiable data were analyzed using Statistical Package for the Social Sciences (SPSS) while qualitative data were analyzed using themes and descriptions.

3. Presentation of findings of the study

3.1 Respondent's Background Information

With regard to gender, the results indicate that there were 46 (66%) male respondents and 24 (34%) female respondents. As for the length of service for the teachers and head teacher participants, it was established that, out of 15 subject teachers who participated in the study, 6 had been teaching for 1 to 5 years, 4 for 6-10 years and 5 for 16-20 years respectively. The length of service head teachers served ranged from 5 years and above. When asked on the grade levels of their schools, head teachers classified 3 schools as being grade ones and 2 schools as grade two.

3.2 Average Number of Pupils per Class

Firstly, the researcher sought to establish the enrolment figures in the sampled school. Table 1 gives the total enrolment of pupils per school as obtained from school head teachers. The results in table 1 clearly indicate the total enrolment levels of pupils per school. When requested to state whether these enrolment levels of pupils in their schools were small or large, all head teachers said that they were large because the number of classrooms, teachers, teaching-learning resources and furniture could not correspond with the number of pupils.

Here introduce the paper, and put a nomenclature if necessary, in a box with the same font size as the rest of the paper. The paragraphs continue from here and are only separated by headings, subheadings, images and formulae. The section headings are arranged by numbers, bold and 9.5 pt. Here follows further instructions for authors.

Table 1: Total Enrolment of Pupils per School

School	Grade	Total Number of Pupils
A	1	1800
B	1	2200
C	2	850
D	1	1897
E	2	997

Table 2 below shows the number of teachers available in the sampled schools and their corresponding shortfalls. The results in table 2 show that each of the 5 schools sampled had a shortfall in the teaching staff. This shortfall ranged from 4 to 8 teachers per school.

Table 2: Total number of teachers at each school

School	Grade of the school	Expected number of teachers	Available teachers	Shortfall in number of teachers
A	1	50	44	6
B	1	50	46	4
C	2	40	32	8
D	1	50	43	7
E	2	40	35	5
Total		230	200	30

On the number of pupils per class as given out by subject teachers during interviews, out of 15 teachers interviewed, 5(33%) teachers had class sizes of 45 pupils and below each, 6(40%) teachers had class sizes of between 46-50 pupils each, while 4(26%) teachers had a class sizes of 51 and above pupils each. Most of the teachers who participated in the study described their classes as being large. Some classes were as large as more than 70 pupils.

On the same question of class size, head teachers reported that there were 12 classes with an average class size of 45 pupils and below each, 15 classes with 46-50 pupils each, and 23 classes with more than 50 pupils each. When requested to state whether these class sizes were large or small, head teachers said there were more large classes than small ones in their schools.

3.3 The average pupil-Teacher ratio (PTR) per school

Table 4 below shows the average pupil-teacher ratio per school. The results in table 4 show that the PTR ranged from 26:1 to 47:1. This therefore means that the average class in sample schools was 45-54 implying that one teacher has to teach between 26-47 pupils per class.

Table 4: Average PTR per School

School	Number of teachers	Number of pupils	Pupil-Teacher Ratio
A	44	1800	40:1
B	46	2200	47:1
C	32	850	26:1
D	43	1897	44:1
E	35	997	28:1

3.4 Effects of high PTR on the Teaching-Learning Process

The study sought to establish the effects of high PTR on the teaching and learning process. Thus, when asked if PTR had an effect on the teaching-learning process, all the categories of respondents observed that class size had an effect on the teaching-learning process. The following were highlighted as the effects of PTR on the teaching-learning process.

3.4.1 Failure to Provide Individualized Attention

One of the effects of a high pupil-teacher ratio is failure by the teacher to provide individualized attention to pupils in class. The majority of the respondents indicated that teachers were unable to provide individualized attention to the learners due to large classes while a few others attributed the teacher's failure to provide individualized attention in their classes to a number of factors that ranged from lack of proper preparation to incompetence and laziness on the part of the teacher. For example, one teacher observed that it was difficult to meet the needs of all the learners when the class size became large. He also pointed out:

Nomatter how well a class is organized, the number of learners in class is the most important factor in that it affects how much time a teacher spends with individual learners.

Another teacher added to say:

Having a large class size could make one feel that they were not always meeting the needs of all the learners in class adequately". "It was also hard to find time to focus on individual learners so often.

Commenting on the benefits of small classes, one teacher said:

A smaller number of learners in my class, allowed me to give more individual attention to the learners on a personal level because I am not rushed in trying to cope with large numbers.

3.4.2 Failure to mark pupils' work

Another effect of a high pupil-teacher ratio is failure by the teacher to mark pupils' work. It was indicated by the majority of the respondents that in small classes, teachers had enough time to check and mark all the pupils' books. Teachers who found it challenging to mark pupils' books due to large classes reported that marking pupils' work took up more and more time as the size of the class increased. For instance, one teacher said:

There was great stress when it came to marking of more than 70 exercise books within a period.

Another teacher also reported that,

Having 80 pupils in class made him think twice about the work he had to plan for the pupils such as practical activities. He also had to consider the quantity of work the pupils were given as the marking became unreasonable if activities were too many.

3.4.3 Failure to Maintain Class Discipline

With regard to class size and discipline, the majority of the respondents observed that it was difficult to maintain discipline in larger classes. Among the reasons given on why large classes caused indiscipline were that when pupils were too many in class, individualized attention became minimal as such pupils felt forgotten, hence engaged in off-task activities such as noise making, fighting and many such off-task activities that would keep them occupied. For example one teacher respondent had this to say:

As numbers rose and space decreases, the level of misbehaviour equally went up, due to proximity of learners. More arguments and less opportunity to physically separate disruptive individuals contributed to the problems of managing and controlling large classes.

Commenting on discipline during focus group discussion, Pupils reported that there was too much noise making in large classes during the learning process, and because of too much noise, concentration on what teachers were teaching was difficult. For example, one pupil said:

In my class, we were 70 of us and because of being too many, there was too much noise and fighting, and our teacher at times failed to identify those who were making noise, as a result she could resort to punishing the whole class, a situation which made

everything go bad because those who felt punished innocently, would also act in an unruly behaviour in the next lesson so as to make up.

In the same line, another pupil said:

In my case, our class was so large that there was a lot of noise making and so just to hear what the teacher was saying proved sometimes futile.

3.4.4 Inadequate Classroom Space for Mobility

With regard to pupil-teacher ratio and classroom space for mobility, the respondents indicated that due to large class sizes, there was the inadequate classroom space for mobility of teachers and pupils for the purpose of group activities consequently, supervision for group activities became poor thereby affecting the quality of learning negatively. One teacher, for example, had this to say:

My class room space is very small and over-crowded such that I even fail to arrange furniture well and the working area is not suitable for the development of maximum learning potential.

Another teacher reported that

"in large classes groups were made large in order to reduce the number of groups in class since space was limited. In some cases, groups were as large as 20 pupils per group and this compromised the quality of teaching".

3.4.5 Inadequate Teaching-Learning Resources

The majority of the respondents also indicated that there were insufficient teaching-learning resources as one critical factor that is influenced by large class size. One teacher, for example, said,

It is difficult to supply adequate expensive materials such as text books to match the rise in class sizes and that this situation affects learning greatly.

Another teacher also added to say,

There are very few relevant books at our school to match the large numbers of pupils in the classes'. For example, Mathematics is one subject area in which 60 pupils in my class share 5 Mathematics text books, a situation which is indeed pathetic and de-motivating to both teachers and pupils.

Furthermore, some pupils in the focus group discussions also reported that there was a critical shortage of books and other learning materials, especially in core subjects like Science, Mathematics, English and Computer studies, a situation they felt compromised their ability to learn effectively. For example, one pupil complained:

At my school, we only have 10 Mathematics books for grade 12, against 65 pupils in class. How then can we share these 10 books? Usually, our teacher has to copy everything for us on the chalkboard and this consumes much time.

3.4.6 Class size and Teacher Exhaustion

With regard to class size and teacher exhaustion, the teacher respondents especially, indicated that large classes led to teacher exhaustion. The respondents observed that teaching large classes was exhausting because one was forced to speak loudly in order for all pupils to hear him or her, and as a result of this, one would be very tired by the end of the day. For example, one respondent had this to say:

Teaching small classes, teachers would be less tired, more productive and develop more positive interactions as well as effective communications with learners because the number of pupils is manageable in terms of discipline, identification and giving individual attention.

3.5 Challenges Associated with teaching large Classes

The following are some of the challenges associated with teaching large classes as reported by subject teachers:

3.5.1 Poor Teacher-Pupil Interaction

Teacher-pupil interaction was mentioned by the majority of the respondents as yet another factor influenced by class size. Commenting on how teacher-pupil interaction is affected, one teacher said that:

It was very difficult to get around and see on a one-to-one basis each learner when one had a large class because time could not allow seeing each and every individual learner in a class of 70 pupils.

Another teacher also noted that,

Pupils with learning difficulties and slow learners did not get a fair deal in a large class because they were not given the desired attention.

3.5.2 Inadequate Classroom Furniture

Non availability of adequate furniture to match the rising numbers of pupils in the classes was mentioned by the majority of the respondents as another factor affecting class size. The respondents reported that due to inadequate desks in the classrooms, pupils were forced to squeeze on the few available

desks and some to sit on the floor. The situation was worse in large classes because in some cases there were classrooms with as few as five desks to be shared amongst a class of 70 pupils. For example, during focus group discussion with Pupils, One pupil said:

In our class, due to inadequate furniture, we are made to squeeze on the few available desks. Desks meant for three pupils were being shared by 4-5 pupils per desk in order to accommodate all of us.

3.5.3 Poor Pupil Motivation

The majority of the respondents observed that motivation was an important factor in the teaching/learning process which unfortunately may be affected by high pupil-teacher ratio. They argued that the most difficult part of teaching large classes was motivation. One teacher said,

Motivation of a smaller number of pupils is easier than motivating a bigger number because each learner had different needs.

3.5.4 Failure to Administer Homework

The majority of the teacher respondents admitted failing to give pupils home work because they had no time to mark all the books for pupils. One teacher reported that if he gave home work to a class of 80 pupils, it would take him a long time to finish marking and at the end of it all that home work would serve no purpose.

3.6 Measures to Mitigate the Impact of High Pupil-Teacher Ratio

When asked on the measures that should be taken to mitigate the impact of large classes on the teaching-learning process in public secondary schools, the respondents gave out the following responses: Firstly, the respondents observed that employing all trained teachers immediately upon graduation would go a long way towards solving the problem of having large classes. Teacher respondents were also of the view that there should be timely replacement of teachers who were being transferred, retired, resigning, promoted to administrative posts and those who were dying. For example, one respondent said:

The impact of high pupil-teacher ratio can have lasting consequences if not adequately checked. I am of the view that the cheapest and perhaps most viable solution is to ensure that all graduating teachers are there and then deployed so as to increase the number of teachers in schools.

Another respondent also added to say:

At times the government through the Ministry of General Education to take a proactive approach where by all teachers leaving the Ministry due to whatever reason should immediately be replaced than just waiting for deployment period which usually comes once per year or sometimes even after two to three years.

Another measure recommended by the teacher respondents was that there must be continuous construction of more schools, especially in densely populated areas of the district. In terms of existing schools, the respondents proposed that more classrooms be constructed in existing schools which had large classes. When it comes to the teaching-learning materials, teachers recommended that the Ministry of Education should ensure continuous supply of both teaching-learning resources as well as furniture in all schools. One respondent had this to say:

There is also need to expand the existing infrastructures as well as construction of new classroom blocks to accommodate the ever increasing number of pupils in these schools. Clearly, there is no logic where you keep on increasing the pupil enrolment yet the infrastructures remain the same for many years. The end result is certainly compromised quality of teaching and learning.

The last comment was that the Government should work towards improving conditions of service for teachers in order to retain the existing staff as well as attract back those who had left the teaching service for greener pastures. For example, one respondent indicated:

The government of the Republic of Zambia through the Ministry of General Education to consider introducing incentives to teachers so as to retain them and / or attract back those who might have left the teaching service for greener pasture

4. Discussion of the Findings

4.1 The Proportion of Pupils in an Average Class Size

To assess the effects of high pupil-teacher ratio on teaching and learning process, it was prudent to begin by establishing the proportion of pupils per class. The study has revealed that the average class size in the sampled schools was 46-50 pupils. These findings clearly show that most public secondary schools in urban areas have large classes. Previous findings also observed that because of free basic education most schools were overcrowded resulting in difficulties of class management.⁵ These figures are also in line with the statistics that Ministry of Education (MOE) obtained in its survey of pupil-teacher ratio in 1992 when it came up with a national average class size of 61.9 pupils per class.⁶

4.2 The Teacher-Pupil Ratio

The study further sought to establish the teacher-pupil ratio in the sampled schools. Research findings revealed that the pupil-teacher ratio ranged from 45:1 to 54:1. The range of pupil-teacher ratio revealed in this study is very similar with the findings reflected in the MOE Statistical Report which showed a pupil-teacher ratio of about 52:1.⁷ This ratio is quite high for effective classroom delivery of the teaching-learning process. This ratio implies that in a

period of 40 minutes, the teacher will on average have to spend less than a minute on each pupil if he or she has to attend to each and every pupil individually. This therefore, implies that in a large class, some pupils with problems that may need the teacher's attention may miss out due to limited time that the teacher may have. Lower staff-child ratios were associated with better outcomes in early childhood education programmes. Subsequent studies in a variety of countries around the world have demonstrated that staff-child ratio is a critical determinant of high quality in early childhood education.⁸

4.3. Effects of High Pupil-Teacher Ratio on the Teaching-Learning Process

The following are some of the effects that high pupil-teacher ratio has on the teaching-learning process as revealed by the study:

4.3.1 Class Size and Pupil Participation

From the observation made as well as from the responses made by the respondents, the study revealed that there was more pupil participation in class activities in small classes than in large ones. In-fact, the researcher observed that in large classes, pupils hardly asked questions. The only activity that pupils were involved in was listening and copying down of notes. Teachers were also in a hurry to teach topics instead of teaching pupils. This means that teachers were more concerned with completing their syllabi instead of getting concerned with whether pupils understood their lessons or not. Other studies revealed that pupils enrolled in small classes were noticeably more engaged in the classroom experience.⁹ The implication here is that since active involvement in the classroom experience is strongly correlated with pupil retention the findings of reduced levels of active class involvement in large-sized classes may have disturbing implications for pupil retention in schools. The researcher therefore feels that it is very important for teachers to understand that participation of the learners in the lesson is very vital because when learners participate in the lesson it enables them to understand the lesson better than when they are passive.

4.3.2 Class Size and Pupil Discipline

When it comes to class size and discipline, the study revealed that the larger the class, the more undisciplined it became. Discipline was mentioned by the majority of the respondents as a factor which is influenced by class size. The researcher also observed that in small classes, there were less discipline cases than in a large classes because pupils were aware that the teacher was observing whatever they were doing and so they refrained from unruly behaviour.

It was noticed that in large classes there was too much noise making during the teaching-learning process, and because of too much noise, concentration on what teachers were teaching was difficult. Previous research showed that a small class enabled teachers to know their learners better and could easily recognize their problems and special needs early.¹⁰ As for the learners, they were more likely to be on-task and less likely to talk amongst themselves. In addition learners in small classes were more likely to create fewer discipline problems and engage in more pro-social behaviour, thereby allowing teachers to devote more time to teaching and less time to controlling the class.

4.3.3 Class Size and Teaching Styles

With regard to class size and teaching styles, the study revealed that class size affected the choice of the teaching styles. The researcher observed that in small classes it was easier to effectively use learner-centered methods such as field trip; project method and group work because managing a small number of pupils when using learner-centered methods such as a field trip was easier than managing a large number. Most of the times, pupils in larger classes were in the classroom listening to the teacher's voice and instructions. A similar study found that smaller classes provided the opportunity for more individualized instructions and help during the teaching-learning process.¹¹

Similarly, small classes had an advantage over large classes when it comes to the employment of a variety of learner-centered teaching styles such as discussion, project, role-play and many such teaching styles.¹² It is clear that a large class has an impact on the choice of the teaching methods since teachers have to adjust their teaching methods according to the number of pupils in their classes.¹³ In addition, a large class may be a limiting factor in the choice of teaching methods. Thus, some styles may not be employed at all thereby depriving some pupils who would have benefited from the use of such styles.¹⁴

4.3.4 Class Size and Assessment

In terms of class size and assessment, the study revealed that assessment was another teaching-learning process that was affected by high pupil-teacher. It was noticed that in small classes, marking of pupils' books took up less time, and immediate feedback was given to pupils on their performance, and this enabled pupils to work on their weaknesses immediately but in a large class, marking pupils' work took too long and the feedback to pupils was often delayed. This in the end frustrated pupils' performance. It was noted that owing to large classes, the option that most teachers had was to reduce the amount of activities and frequency for assessment, although this compromised the quality of work. Teachers believed that the evaluation process was different in large and small classes. According to the findings of this study, teachers working in small classes were more satisfied because marking took little time, corrections were immediate and details were provided to guide the child whereas in large classes, marking was time consuming, and sometimes delayed. Similarly, teachers of large classes admitted attempting limiting the amount of work and activities they had to assess.¹⁵

From what was observed and heard, it is apparent that assessment in large classes was not effectively being carried out. It is however, important to note that assessment in the teaching-learning process serves many purposes. It can grade the

attainment of learners, help to select candidates for jobs or future courses, contribute to evidence on the effectiveness of courses and teachers, and provide a long term goal for learners. For assessment in the classroom to be effective it must be on-going so that it provides judgment on whether, and to what extent, learning has been successful, and to pinpoint difficulties for remedial action to be taken.

4.3.5 Class Size and Identification of Pupils with Learning Problems

Coming to class size and identification of pupils with learning problems the study findings revealed that a small number of pupils in class allowed teachers to easily identify and provide children with learning difficulties with the much needed individualized help on curriculum areas where they were finding problems. This in turn helped slow learners to catch up with their peers in the same classroom. This is in line with previous research findings that showed that small classes promoted the interactions between teachers and pupils. These interactions helped the teacher to understand individual pupils' capabilities and weaknesses.¹⁶

4.3.6 Pupil-Teacher Ratio and Motivation of Learners

In terms of pupil-teacher ratio and motivation, the study revealed that learner motivation is captivated in a smaller class than in a large one because different pupils have different needs. Earlier studies revealed that class size has an effect on the motivation of pupils in that motivating children in small classes was easier than motivating them in large classes because each child in class is motivated differently according to his/her needs and characteristics.¹⁷

4.4 Challenges Associated with High Pupil-Teacher Ratio

In terms of challenges associated with teaching and learning in large classes, the major areas of concern that came out prominently were as follows;

4.4.1 High Pupil-Teacher Ratio and Teacher-Pupil Interaction

In terms of class size and pupil-teacher relationship, the study revealed that as the class increased, the number of interactions with individual pupils decreased, and this adversely affected pupils' progress. Responses from teachers revealed that it was very difficult to get around and see on a one-to-one basis each child in a large class, because time might not allow you to see each individual in a class of about 70 or more pupils. The teacher would not fully interact with all the individual pupils in a large class, and consequently the teacher might not come to understand each and every pupil's ability and disability.¹⁸ Ultimately, this might result in the teacher's failure in structuring the teaching-learning materials for meaningful learning of each and every pupil.

4.4.2 Pupil-Teacher Ratio and Learning Pupils' Names

In terms of learning pupils' names, the researcher established that it was difficult for most teachers teaching large classes to learn pupils' names quickly because of the numbers involved. It was noted that as a class increased in numbers it became difficult for most teachers to learn pupils' names and to get to know them personally. "As classes increased, it became impossible to learn all the pupils' names and to get to know them personally and quickly."¹⁹ Thus, pupil anonymity was a problem in many contexts. When pupils felt that their teacher did not know them, it was easier for them to be disruptive, argue about trivia things, arrive late or leave early, miss class and disengage from the lesson, thus, missing on what the teacher was teaching.

4.4.3 PTR and the Availability of the Teaching-Learning Resources

The study revealed that there were very few relevant books in schools to match the large numbers of pupils in the classes. For example, the researcher observed that in one class of 62 pupils, 5 mathematics text books were shared among the 62 pupils, meaning that one book was shared among 12 pupils on average. It was also observed that, due to inadequate teaching-learning resources, teachers were forced to write down all the class activities on the chalkboard, including drawing maps and graphs. This situation consumed much of their teaching time. Earlier studies observed that learning is severely hampered by an undersupply of basic textbooks and other teaching learning materials. This is so because pupils, who do not have their textbooks to study and take home, do not perform as well as those who have them.²⁰

4.4.4 PTR and Classroom Furniture

The study revealed that inadequate supply of furniture to match the rising numbers of pupils was another factor affecting large classes. The researcher observed that due to inadequate desks in the classrooms, pupils were forced to squeeze on the few available desks, and some to sit on the floor when learning. Sitting on the floor demoralized pupils and had a negative effect on their handwriting as well. "Furniture makes classroom environment conducive for effective teaching learning process."²¹ On the other hand if the learners are having a hard time taking down notes because of not being comfortable when seated, it may hinder them from effective learning, and at the same time sitting on the floor may be detrimental to their health, particularly posture.

4.4.5 PTR and Homework

With regard to pupil-teacher ratio and homework, the study revealed that most teachers did not give pupils home work because they had no time to mark all the books for pupils. Furthermore teachers feared giving home work to large classes because if they gave homework to a class which was as large as 80 pupils and more, it would take them a long time to finish marking, and at the end of it all, that home work would serve no purpose. This implies that the

quality of teaching is comprised in the sense that pupils are pre occupied with other activities whenever they are out of school. Homework is meant to keep pupils busy with school work even when they are at home and also to develop a culture of research in them.

5. Conclusion

The study was conducted to investigate the effects of pupil-teacher ratio on the teaching-learning process of mathematics in selected Public Secondary Schools. The study showed that there was a close relationship between the size of the pupil-teacher ratio and the quality of outcomes. Where the ratios were bigger, results revealed that the quality of interaction between teachers and learners declined significantly, meaning that learners did not get optimal opportunities to get their personal challenges addressed by their teachers, and this adversely affected pupils' performance in class. The consequence of the teacher's failure to fully interact with all the learners was that teachers could not understand each and every pupil's ability and disability, and hence planning for them.

The study also revealed that as classes increased in size, teachers were challenged with the use of learner-centered teaching methods such as project method, field trips, demonstration, experimental, group work and many such methods that required monitoring of learners' participation by the teacher. Instead, teachers relied more on whole class teaching methods which did not require individual attention but such methods reduced pupils' participation to listening only without any hands-on experience resulting in superficiality of learning and poor performance in both examinations and in the world of work. In terms of marking pupils' work, the study found that in small classes, teachers finished marking pupils' books within a period and corrections were done immediately in class while in large classes teachers never finished marking pupils' work within a period.

Large groups of pupils were also found to lead to chaotic classroom atmospheres where learners do not get an opportunity to have meaningful interaction with teachers and with peers. Consequently, children who learn in overcrowded conditions have been found to have lower social competences, decreased creativity, and poor language development. In short, the study found that large classes had generally adverse effects on the teaching-learning process, mediated primarily by lowering pupils' level of engagement (active involvement) with the teacher, with classmates and with the subject matter. In addition, large classes were found not to be as effective as small classes for retention of knowledge, critical thinking and attitude change.

6. Recommendations

Basing on the findings of the study, the following recommendations that may help to mitigate the effects of large classes on the teaching-learning process in public secondary schools were made:

- (i) The Ministry of Education should come up with a limit with regard to the number of pupils that can effectively be handled by a single teacher in a single session. As at now schools have been instructed not to deny any child a place so that the Government can attain the Sustainable Development Goal on education which is about increasing access of education to all.
- (ii) The Government should recruit all graduating student-teachers upon their graduation from colleges and universities of education in order to increase staffing levels in schools and reduce the pupil-teacher ratio.
- (iii) The Government should replace all the teachers who are retiring, resigning, and being dismissed and dying in order to maintain the number of teachers required in schools.
- (iv) The Ministry of Education should increase its budgetary allocation for infrastructure development and procurement of desks and teaching-learning resources in public secondary schools in order to increase the number of classrooms, so as to reduce overcrowding in the few classrooms available.
- (v) School desks as well as the teaching-learning resources should continuously be supplied in schools by the Ministry of Education and priority should be given to schools in densely populated areas around the country.

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