

Influence of Institutional Variables on Numeracy Levels among Lower Primary School Pupils in Kiambu County- Kenya

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Abstract— Undoubtedly, the aim of formal education is to enable children to develop knowledge and competencies required to thrive in the world of work - industry, technology, science and commerce. To achieve these children must acquire basic numeracy skills that are critical in predictive of children's future school attainment. In addition, numeracy skills are important for individual activities such as problem solving. Despite the indisputably importance of mathematics pupils' numeracy levels in lower primary in Kiambu county, is perennially low and yet most important skills of numeracy are acquired at the foundational basic level of a child's learning. This study examined the influence of institutional variables on numeracy levels among lower primary school pupils in Kiambu County, Kenya. This paper focuses on two objectives of the study: to examine the influence of school physical facilities on numeracy level among lower primary school pupils and to establish the influence of availability of teaching and learning materials on numeracy levels among lower primary school pupils in Kiambu County. The study adopted a descriptive survey design. A sample size of 84 respondents comprising of 42 head teachers and 42 lower primary school teachers was obtained through stratified sampling, simple random sampling and purposive sampling techniques. Questionnaire, interview schedule and observation check list were used in data collection. Quantitative data was analyzed descriptively using frequencies and percentages and presented in tables while qualitative data was analyzed thematically based on the research objectives and presented in narrative forms. The findings revealed that school physical facilities and teaching/learning materials influenced classroom learning environment which contributed to low numeracy levels in lower primary schools in Kiambu County. It was recommended that parents be sensitized to participate in initiatives to help primary schools get funds for physical facilities and teaching /learning materials. Furthermore, government agencies such as County Development Funds (CDF) and county Government funding be increased to help improve school physical facilities. More so, the Government should increase the Free Primary School funding to enable schools buy more teaching/learning materials and improve school infrastructure.

Index Terms— Numeracy, Physical facilities, Teaching/Learning materials.

I. INTRODUCTION

Education is globally used as means of addressing poverty, disparities and promoting better living standards (Tarabini, 2010). Education is also believed to give skills, knowledge and attitudes to prepare individuals for employment geared

towards raising living standards (Chang'ach&Kessio, 2012). Limboro (2019) asserts that provision of quality education is the cornerstone to improving people's lives and sustainable development. According to Lindeman, (2015) people who are educated have the resolve and ability for creativity and resource deployment for growth and development.

Goodman, Finnegan, Mohadger, Krenzke& Hogan (2013) define numeracy as the capacity to admittance, utilize, interpret and transfer facts in mathematics and thoughts, in order to get involved in and manage mathematical demands of several circumstances in later years. Numeracy is significant in development of logical thinking and cognitive strategies in their daily activities (Anthony &Walshaw, 2009). Haylock & Manning (2014) contend that numeracy is desirable in solving problems and making sense of time, patterns, shapes and numbers.

Limboro (2019) opines that while it is generally accepted that learning can take place anywhere, positive learning outcomes commonly pursued by educational systems happen in quality learning environments that are healthy, safe, protective and provide adequate facilities and resources. Kekare (2015) observed that determinants of learning outcomes among learners include school enabling conditions (literacy environment) which include school physical facilities and adequate resources.

Bernelius&Kauppinen (2012) showed that school classroom situation (space, desks, tables and learning aids) highly influences the developmental and academic achievement of pupils. Thapa, Cohen, Guffey& Higgins-D'Alessandro (2013) posits that school amenities such as accessibility of toilets and libraries influences educational outcomes of pupils. Research evidence indicate that pupils in schools with adequate toilets,well-made classrooms and access to libralies, achieve higher than those in schools with inadequate toilets, poor classrooms and inadequate or unaccessible libraries (Nowicki, Sullivan-Watts, Shim, Young, &Pockalny2013).

Chingos& Whitehurst (2012) noted instructional materials as that which teachers utilize to accomplishtheir set goals and lack of educational resources in is a barrier to effective instructional process that has a bearing to learning outcome. Bygate, Swain and Skehan (2013) stresses that materials such as text books and syllabus regulate instruction and that teaching aids are core to instruction and one of the most significant effects on classroom activities.

Wainaina (2015) investigated how physical conditions in the classroom influence instruction among early childhood

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learners in Nyandarua County. The study concluded that classroom conditions such as, space, desk/tables and lighting had an effect on learning among the children. Bad classrooms in public pre-schools included overcrowding in classes caused by high enrollment, inadequate desks/tables and fewer text books were not appropriate for learning. Findings showed that children in classes with good environments achieved higher attainment in the skills evaluated.

Limboro (2019) investigated availability of playing ground in urban schools. She instituted that out of the four schools considered, only two schools had a playing ground. However, the space in one of schools was inadequate to cater for a huge population of more than 800 pupils. As a result a majority of the learners remained in the classroom during breaktime thereby missing out on the health benefits of physical activity that is key to learning. Adeogun & Olisaemeka (2011), expressed that playing fields emphatically impacted understudy's exhibition, improves learners confidence, self esteem and strengthens their believe system which may result in improved academic performance.

Ruthiri (2009) found instructional resources acquisition was hard to many schools because of inadequate finances. Moreover, Limboro (2019) examined availability of school quality inputs such as physical facilities and resources and their influence on pupils' achievement in urban slums of Nairobi. She found that physical facilities such as classroom, desks, libraries and resource materials such as stationery and text books and teaching aids which are needed in the teaching learning process were also grossly missing in the four schools that were studied. The schools heavily relied on donors and well-wishers for supplies and this had a negative effect on learner's academic attainment.

Lack of books, syllabus and teaching aids by teachers was also found to affect learner attainment. In Nyamira North, Okongo et al, (2015) examined the influence of teaching learning materials (TLM) on inclusive education implementation in pre-schools. Results showed that inadequate books, syllabus and teaching aids negatively influenced implementation of inclusive education.

Although there are initiatives by Kenya Government (GoK) in collaboration with other stakeholders such as Kenya Primary Maths and Reading (PRIMR) project, TUSOME & Early Grade Mathematics Assessment (EGMA) by USAID, African Maths Initiative (AMI) and the Kenya Primary Development Project (PRIEDE) to improve the lower primary school pupils' academic competencies in early grade literacy and numeracy, UWEZO (2016) report indicates that there seems to be minimal improvement.

In Kiambu County, performance in lower primary (classes 1-3) is poor despite the County being economically well endowed (UWEZO 2015). According to UWEZO (2015), only 39.5% of pupils in class 3 could do class 2 work in numeracy and 11 out of 100 children completed class 8 without having the basic numeracy skills acquired in class 2. Only 47.3% of pupils in class 3 could do basic everyday mathematics. Further learning outcomes were inequitably distributed across districts in the county. The report indicated that only 59 out of 100 class 3 pupils in Gatundu District could do class 2 mathematics compared to 64 out of 100 in

Kikuyu District.

Miheso (2012) posits that for years, mathematics attainment of pupils in the Kenya Certificate of Primary Examination (KCPE) has been poor and the rate of failure has constantly been above 50% and is on growing trend. According to UWEZO (2016), 52.9% of pupils in class 3 in Kenya can not do class two mathematics. A study, by Kenya National Examinations Council (KNEC) - conducted in 2017, monitored learning achievements in literacy and numeracy levels, indicate that a considerable percentage of pupils did not reach the 50% benchmark in all the the mathematical operations and number patterns. Therefore to avoid this trend, a firm foundation in Early Childhood Development Education (ECDE) and lower primary is needed.

According to National Examinations Council (KNEC) (2018), Kenya Certificate of Primary Education (KCPE) results for the last three years (2016-2018) indicated that most candidates had scored below 50% in most of primary schools in Kiambu County. Notably, Gatundu North was most hit with amajority primary schoolsscoring an average of 39.0 % in mathematics in KCPE results since 2016.

Available evidence from several studies (Limboro 2019, Miheso 2012, Wananaina 2015, Bernelius & Kauppinen 2012) indicates a favourable classroom and the surrounding environment is critical. Consequently, owing to indisputable importance of mathematics and evidence of its dismal performance among lower primary school children in both public and private schools in Kiambu county, informed the need for this study.

II. STATEMENT OF THE PROBLEM

Despite the crucial role of mathematics in the technological development of any country, dismal performance by primary school pupils in mathematics is still a persistent problem in many schools in the country (Miheso, 2012); a problem alluded to weak background in the lower primary. This has serious of implications since the speed or pace of industrialization and adoption of appropriate technologies is a positive indicator, to society's level of mathematical attainment (KNBS, 2019). Despite the importance attached to student's mathematics achievement globally, performance of lower primary school pupils in Kiambu County continues to deteriorate (Uwezo, 2015/2016). In Kiambu County, Gatundu North Sub-County has many primary school pupils performing dismally in mathematics (KNEC, 2017/2018/2019). Thus, a study to investigate the factors that have contributed to dismal performance in mathematics by primary schools was vital. This was crucial due to death of knowledge in the area yet mathematics achievement contributes to Kenya's technological development and industrialization (GoK, 2017).

III. THEORETICAL FRAMEWORK

This study was guided by the Ecological Systems' Theory also called the Bio-ecological Theory by Bronfenbrenner (1986). The theory argues that the pupil's biological characteristics and the physical environment in which he/she grows collectively influence pupil numeracy. He observed that a pupil is at the center being bounded by environmental

systems.

Bronfenbrenner argued that both the environment and the learner influence one another bi-directionally and that variations or disagreement in any one layer affects all other layers of environments. Hence, an ideal and enabling environment helps the pupil to grow and progress in life. In school, many factors influence a pupils' level of numeracy. These factors includes the school's physical facilities and the school Teaching Learning Materials.

This theory is relevant to this study because it clarifies that, the environment in which pupils are exposed to, influence how she/he grows and develops leading to the success or failure of the pupil's acquisition of numeracy skills. This theory help explain how the *school physical facilities* and *Teachig/Learning Materials* interact with a pupil to either promote or hinder the acquisition and development of numeacy skills.

IV. RESEARCH METHODOLOGY

A) Research Design

Table I: Sample size

School Category	Head Teachers	Teachers	Total	Percentage of Sample Size
Public Schools	30	30	60	16.1%
Private School	12	12	24	16.8%
Total	42	42	84	16.3%

C) Data Collection Methods

Questionnaire, interview schedule and observation check list/schedule were used to collect data.

D) Data Analysis

Quantitative and qualitative data processing and analysis began with editing questionnaires to minimize errors then coding for the open ended data analysis and then interpretation. The statistical package for social science (SPSS) was used to make descriptive analysis. Percentages and frequency distribution were displayed automatically reporting on availability and adequacy of school physical facilities and availability of TLMs in lower primary schools in Gatundu North Sub-County. Qualitative data was analyzed

The study employed descriptive research design that employed mixed methods approach (quantitative and qualitative methods) in data collection. This approach was suitable for this study since it focused on the measurement and analysis of exploratory, descriptive, and/or explanatory variables (Grinnell &Unrau, 2014) thereafter giving an explanation of the phenomena on the study (Tashakkori&Teddle,2010).

B) Sample Size

From a target population of 104 head teachers and 516 teachers, in both public and private schools, 42 head teachers and 42 lower primary school teachers formed the sample. Mugenda and Mugenda (2003) postulate that, for a large population a sample of 10% - 30% is sufficient. This study therefore used a sample size of 84 respondents. This is 15.9 % of the target population.

using descriptive statistics such as frequencies and percentages and presented in narrative forms and by use of tables. The researcher explained the meaning of the captured data using text then made conclusion.

E) Questionnaire Return Rate

All the 42 sampled teachers returned questionnaire. This presents a return rate of 100%. Moreover, only 35 out of 42 sampled Head Teachers were available for interview schedule. This presents a response rate of 83.3%. The researcher therefore met the 50% threshold as idicated by Mugenda and Mugenda (2003) . Table 2 shows the questionnaire response return rate.

Table II: Questionnaire Return Rate

School Category	Head Teachers	Teachers	Total	%
Public Schools	24	30	54	90.0%
Private School	11	12	23	95.8%
Total	35	42	77	91.6%

V. RESULTS AND DISCUSSIONS

A) Research Design

This section presents data analysis and interpretation guided by the following research objectives:

- i. To examine the influence of physical facilities on numeracy level among lower primary school pupils

in Kiambu County.

- ii. To establish the influence of the availability of teaching and learning materials on numeracy level among lower primary school pupils in Kiambu County.

B) Influence of Physical Facilities on Numeracy Level among Lower Primary School Pupils in Kiambu

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County

The study sought to establish the influence of physical facilities on numeracy of lower primary school pupils in Kiambu County

C) Physical Facilities

The study investigated availability physical facilities that included, Classrooms, desks library, toilets and playing ground. Teachers were asked to rate the above physical

facilities in their respective schools as: adequately available, fairly available and not available. The findings from teachers are summarized and presented in table 3.

Table III: Teachers Views on Availability of Physical Facilities

PHYSICAL FACILITIES	School Category	Adequately Available		Fairly Available		F	%
		F	%	F	%		
Classrooms	Public	19	63.3	11	36.7	-	-
	Private	8	66.6	4	33.3	-	-
Desks	Public	10	33.3	20	66.7	-	-
	Private	8	66.6	4	33.3	-	-
Library	Public	4	13.3	9	30.0	17	56.7
	Private	4	33.3	4	33.3	5	41.7
Toilets	Public	7	23.3	10	33.3	13	43.3
	Private	5	41.7	4	33.3	3	25.0
Play ground	Public	8	26.7	15	50.0	7	23.3
	Private	2	16.6	3	25.0	7	58.3

Overall, Table 3 shows that more schools (56.7%; 43.3%) from public sector did not have a library and toilets compared to 41.7% and 25% private schools respectively. Further, private schools had two times (66.3%) number of schools with adequate desks compared to public schools (33.3%). However, more schools (58.3%) from the private category did not have playing fields compared to 23.3% public schools. This finding compliments Limboro (2019), who found that playing fields were missing in 50% urban slums primary schools thus, hindering physical education programs that are acknowledged to be the fundamentals of a healthful lifestyle that contributes to both physical fitness and cognitive development or achievement.

Through observation, the study observed that basic physical facilities such as classrooms, toilets, proper school buildings and desks in most of the schools in Gatundu North did not meet the Ministry of Education (MoE) 2012 recommended standards of 30-40 pupils per classroom; 3:1 pupil desk-ratio and 35:1 and 30:1 pupil-toilet ratio for boys and girls respectively. Many of the public schools (67%), lacked enough desks and chairs while some of the desks were broken. Pupils were congested on uncomfortable forms and tables. The study noted that the number of pupils in each

classroom was about 60-70 on average. This is an indication that physical facilities in majority of the schools in Gatundu North Sub-County were inadequate. This finding corroborates Limboro (2019) finding that classrooms, desks and toilets were grossly inadequate in primary schools in urban slums and this negatively affected learning achievement in numeracy and literacy.

Interview with Head Teachers indicated that public schools lacked adequate finances for physical facilities. A majority (68.6%) of the Head Teachers in the public sector indicated that, schools did not have adequate finances and as result, schools were unable to improve physical facilities or acquire adequate facilities such as desks. The study compliment Ruthiri (2009) who found that, physical facilities acquisition was hard to many schools because of inadequate finances. On the other hand, majority of private schools received financial support from parents and sponsors such as church missionaries and private companies and this may explain why they were better endowed with physical facilities

The study further analyzed attainments in numeracy scores across schools by computing pupils mean scores for end of term one numeracy examinations (done on March 2019). The results are presented in table 4.

Table IV: Physical Facilities and Pupils' Numeracy Scores achievements

PHYSICAL FACILITIES	School Category	Adequately available	Numeracy Mean Scores	Fairly Available	Numeracy Mean Scores	Not Available	Numeracy Mean Score
Classrooms	Public	19	48.3	11	48.7	-	-
	Private	8	61.2	4	48.8	-	-
Desk	Public	10	49.0	20	47.0	-	-
	Private	8	61.2	4	48.8	-	-
Library	Public	4	50.0	9	46.1	17	39.8

Toilets	<i>Private</i>	4	63.4	4	58.8	5	46.3
	<i>Public</i>	7	49.1	10	46.8	13	42.2
Play ground	<i>Private</i>	5	60.1	4	58.8	3	46.1
	<i>Public</i>	8	49.5	15	43.4	7	42.5
	<i>Private</i>	2	63.5	3	61.8	7	47.1

Table 4 above shows that, schools with adequate physical facilities, (classrooms, desks, library, toilets and playing ground) performed better in mathematics than schools where the physical facilities were not available. Public schools that reported library, toilets and playing ground as adequately available had higher numeracy means of 50%,49.1% and 49.5% respectfully. Conversely, public schools without libraries, toilets and playing ground recorded lower numeracy mean scores of 39.8%,42.2%, and 42.5% respectfully. Notably, numeracy scores for private primary schools were far above those of public primary schools. This variance in performance could be explained by different environmental factors such as availability of physical facilities, because more schools in private sector had adequate physical facilities. The finding concurs with Sabitu, Babatunde and Oluwole (2012) which revealed that nature and availability of school facilities influence academic achievement of learners both in public and private schools.

From interviews with Head Teachers on the effect of inadequate physical facilities on pupils' numeracy level, a majority (74.3%) of the head teachers in public schools indicated that, inadequate physical facilities contributed to low numeracy levels in their respective schools. They explained that, congested classrooms and desks were not conducive for learning since learners were uncomfortable. Furthermore inadequate toilets led to time wastage as the

pupils waited to access the facilities. Further they reported that, Lack of playing fields denied pupils an opportunity to benefit from physical exercise which is vital for healthy life style and has a bearing on physical and cognitive development. This concurs with Limboro (2019), who revealed that, while it is generally accepted that learning can take place anywhere, positive learning outcomes commonly pursued by educational systems happen in quality learning environments that are healthy, safe, protective, and gender-sensitive; and provide adequate facilities and resources.

D) Influence of the Availability of Teaching and Learning Materials on Numeracy Level among Lower Primary School Pupils in Kiambu County

The study sought to find out the influence of the availability of Teaching and Learning Materials on development of numeracy skills.

E) Availability of Teaching and Learning Materials (TLMs)

Through questionnaire teachers were asked to indicate the TLMs that were available and those not available. Table 5 presents the findings.

Table V: Teachers Views on Availability of TLMs

Teaching and Learning Materials (TLMs)	School Category	Available		Not available	
		F	%	F	%
Course books	<i>Public</i>	18	60.0%	12	40.0%
	<i>Private</i>	10	83.3%	2	16.7%
Charts and other Teaching aids	<i>Public</i>	9	30.0%	21	70.0%
	<i>Private</i>	7	58.3%	5	41.7%
Syllabus	<i>Public</i>	12	40.0%	18	60.0%
	<i>Private</i>	8	66.7%	4	33.3%
Teachers guide	<i>Public</i>	16	53.3%	14	46.7%
	<i>Private</i>	9	75.0%	3	25.0%

Table 5 shows that 40% and 16.7% of the sampled schools from public and private sectors respectively did not have mathematics course books. The study observed that, teachers in schools that lacked course books used teachers' notes and photocopied materials to teach mathematics. Additionally, it was observed that, some teachers had borrowed course books from the nearby private schools, an indication that the public schools were the most hit by shortage of course books as shown in the table. Further, a majority (70%) of the public schools did not have charts and other teaching aids, while 60% and 46.7% of the public schools lacked syllabus and Teachers guide respectfully. It is critical to note that more schools from the public sectors did not have sufficient TLMs

as compared to private schools. Chingos and Whitehurst (2012) noted that instructional materials as that which the teachers utilize to accomplish his set goals. They further established that ideally, no effective instruction can occur without equipment, facilities, and materials thus leading to poor learning outcomes.

Through interviews, a majority of the head teachers indicated that, TLMs such as course books, teaching aids and Teachers Guides were inadequate in most public schools as they heavily relied on donors and well-wishers for supplies. Nevertheless, private schools were better resourced in terms of books courtesy of parents and private donors. The Head teachers further reported that, lack of funds was the main

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hindrance to acquisition of course books and other TLMs. This study corroborates Limboro (2019) who found that, acquisition of learning resources in low cost private schools in urban slums schools was hard because the schools heavily

relied on funding from development partners or donors for support.

The researcher further sought to determine pupils' text book ratio in mathematics Results are summarized in table 6.

Table VI: Pupils-Mathematics Textbooks Ratio

Pupils to textbooks ratio	Percentage		
	Public Schools	Private Schools	Overall
1:1	10.0%	16.7%	11.9%
2:1	13.3%	25.0%	16.7%
3:1	26.6%	33.3%	28.6%
4(and above):1	50.1%	25.0%	42.9%
Total	100	100	100%

Table 6 above shows that a majority of the public schools (50.1%) had a pupil text book ration of 4:1 which was three times above the Ministry of Education (MoE) requirement of 1:1. Mutai (2006) opined that learning is strengthened when there are enough reference materials such as course books and teaching aids. Consequently, lack of teaching resources in most schools in Kiambu County could be the reason for low numeracy levels in lower primary schools.

Through the interviews with the head teachers, a majority of them revealed that, pupils mainly congested in few desks to access the few available course books and this hampered teaching and learning. In addition, since the text books were limited, pupils were not allowed to carry them home as a way

of mitigating a crisis in case the books got lost. As a result, in most schools text books were collected daily and stored in staff work room. Many head teachers further stated that, pupils were not given home assignments due to lack of text-books; consequently limiting pupils' opportunity to revise or learn after school or weekends.

Moreover, the study analyzed the attainment in numeracy scores by computing mean scores for end of term one numeracy examinations (done on March 2019). The results are presented in table 7.

Table VII: Numeracy Mean Scores Across schools

Teaching and Learning Materials (TLMs)	School Category	Available	Numeracy score	Not available	Numeracy score
Course books	<i>Public</i>	18	50.2	12	41.8
	<i>Private</i>	10	58.2	2	44.6
Charts and other Teaching aids	<i>Public</i>	9	49.5	21	39.3
	<i>Private</i>	7	61.2	5	45.2
Syllabus	<i>Public</i>	12	47.1	18	43.1
	<i>Private</i>	8	61.1	4	44.3
Teachers guide	<i>Public</i>	16	45.3	14	42.0
	<i>Private</i>	9	59.7	3	44.8

The table above reveals that, the numeracy mean scores were higher 50.2% and 58.2% in public and private sectors where the numeracy text books were available. Schools without the text books attained a numeracy mean that is below 50% benchmark. Besides, the numeracy scores for private primary schools were far above those of public primary schools. The difference in scores could be due to different environmental factors such as availability of TLMs. Through interviews, most of the Head teachers were of the opinion that lack of course books, teaching aids, syllabus and teachers guide had a bearing on poor performance in numeracy.

Generally, the results shown in the table 7 imply that numeracy levels in lower primary schools were positively influenced by availability of teaching and learning materials. This finding supports Zachariah, (2011) who found that teaching learning resources affected performance in

mathematics in secondary schools in Kenya. The study had found that availability and use of teaching learning materials had positive results among students in mathematics in secondary schools. More so, Lillian, (2015) carried a study on classroom environment on pupils' academic performance in public primary schools in Bungoma South Sub-County. The study found that, 74% schools that lacked teaching materials performed poorly as compared to those which had enough teaching. This study supports Lillian (2015) findings that schools without adequate learning materials performed poorly compared to those well-endowed.

VI. SUMMARY AND CONCLUSIONS OF THE RESEARCH FINDINGS

It is evident that, physical facilities such as classrooms,

desks, toilets, library and playing grounds were grossly inadequate and hence hindering pupils' achievement in numeracy. Inadequate classrooms led to congestion which triggered un conducive learning environment while inadequate toilets/latrines caused time wastage as the pupils waited to access the facilities. Lack of playing fields denied pupils an opportunity to benefit from physical exercise which is vital for healthy life style and has a bearing on physical and cognitive development. Consequently, schools with adequate physical facilities reported higher numeracy scores than schools with inadequate physical facilities.

The study further revealed that TLMs such as course books, teaching aids, syllabus and teachers' guide were inadequate in most primary schools. Having access to adequate books and other teaching and learning materials promotes effective classroom instruction that promotes positive learning achievement by learners. Schools with adequate TLMs reported higher numeracy scores than schools where TLMs were inadequate.

Therefore, the study concluded that, numeracy levels in lower primary schools were negatively or positively influenced by physical facilities and availability of teaching and learning materials.

VII. RECOMMENDATIONS

Based on the study findings, there is need to identify those schools with limited facilities so that communities, the national and county government can help fill the gaps that exist in order to improve numeracy levels in schools. Policies should also be formulated to ensure that head teachers only admit a number of pupils that the school facilities can accommodate to avoid congestion and subsequent compromise of education standards.

Further, the government should increase funding to public primary schools so as to cater for the essential TLMs that is critical to improvement in numeracy, empowering children to develop knowledge and competencies required to thrive in the world of work - industry, technology, science and commerce.

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