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Examining the use of Manipulative Materials in Teaching Mathematics among Junior High School Teachers in the Seikwa Central Circuit

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Abstract: The Ministry of Education (MoE)/Ghana Education Service (GES) require all mathematics teachers to use manipulative materials to teach mathematics in Junior High Schools (JHSs) because they have the potential to demystify learning of the subject. The study was designed to examine the use of manipulative materials in teaching mathematics among junior high school teachers in the Seikwa Central Circuit of the Tain District of the Bono Region. The questionnaire was used to collect data from 15 teachers and 9 headteachers sampled from JHSs in the Seikwa Central Circuit of the Tain district. Descriptive statistical analysis was applied to the quantitative data obtained from the questionnaire. The study showed those teachers use manipulative materials in teaching mathematics in the classroom. Teachers knew the benefits of manipulative materials in learning; two factors challenged their use in the classroom: non-availability and inadequate supply of manipulative materials, and the high cost of preparing some manipulative materials. The study concluded that most JHS teachers in the circuit improvise most of the manipulative materials they use in the classroom since they are not supplied by MOE/GES, NGOs/Philanthropists, Tain district assembly, and PTA/SMC. The study recommended that stakeholders in education in the Seikwa Circuit should boost the supply of manipulative materials and organize periodic in-service training for JHS teachers on the use and development of manipulative materials for teaching mathematics. Lastly, MOE/GES should organize in-service training on the use of problem-solving in teaching mathematics.

Keywords: mathematics, teachers, manipulative materials, Seikwa Central Circuit
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1. Introduction

The role played by mathematics in almost all areas of development in life cannot be underestimated. Mathematics serves as backbone to all technological advancements in the world. There can be no meaningful development in this modern world of technological era without adequate and sufficient knowledge of mathematics. The study of mathematics enhances one's understanding of the world through the language of symbols and abstract representation of phenomena (Cope, 2015). It is a subject that is very important for the academic excellence of people irrespective of programme of study. Knowledge in mathematics is applied in almost every school subject. In Ghana, mathematics features prominently as one of the core subjects in the curricula of basic schools, senior high schools and colleges of education (Ministry of Education, 2012). Mathematics features as one of the critical filters for entry into higher educational programmes.

Despite the importance of mathematics in human development, many investigations have shown that most students in secondary schools are not very much interested in learning mathematics (Eshun, 2000; Awanta, 2000). Also available records indicate unsatisfactory mathematics performance of students in the West African School Certificate Examination (WASCE). The Chief Examiners' Report of West Africa Examinations Council for the past few years have highlighted students' weakness in solving problems in mathematics (WAEC Chief examiner's Report, 2017, 2018, & 2019). Some of the

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persistent weaknesses which have been identified by the Chief Examiner are students' inability to use mathematical skills and concepts.

The Curriculum Research and Development Division (CRDD) see manipulative materials as important tools for teaching and learning of mathematics. All teachers were required to include manipulative materials in preparing their lesson notes and using them in teaching in the classroom (Ministry of Education, 2012). Headteachers and Circuit Supervisors supervise to check the type and appropriateness of manipulative materials teachers use in teaching mathematics and to assist them. Research in mathematics instruction revealed that pupils' mathematics understanding will be more effective if manipulative materials are used (Alghazo & Al-Awidi, 2010, Swan & Marshall, 2010) and this will not make most pupils shy away from it since mathematics is one of the important subjects and pupils know its usefulness. There have been numerous definitions of manipulative materials by several authors. Kennedy (1986) defines manipulative materials as "objects that appeal to several senses and that can be touched, moved about, rearranged, and otherwise handled by children" (p. 6). Smith (2009) defines manipulative materials as "physical objects that are used as teaching tool to engage students in hand-on learning of mathematics" (p.20). Thus manipulative materials are materials that learners can use to learn or form mathematical concepts. Such materials help to reduce the abstract nature of mathematics as perceived by many students. The use of the manipulative materials also arouses learners' interest and promotes active involvement in the lesson (Munger, 2007).

In Ghana, the use of manipulative materials in teaching and learning plays a key role in deepening pupils' understanding of mathematical concepts among at the basic school level (Ministry of Education, 2012 & Cope 2015). When manipulative materials are used in teaching and learning, pupils can easily explore to understand the subject effectively. According to Cope (2015), the use of manipulative materials in teaching mathematics motivates students in learning the subject. In addition, pupils can easily remember what they have learnt. No wonder since the sixties it was believed that, the use of mathematics manipulative materials was often justified on the basis of the ancient proverb: "I hear and I forget", "I see and I remember" and "I do and I understand" (as cited in Mohd & Mohd, 2010). This proverb is still relevant today and used as a justification for the use of manipulative materials. This proverb has a ring of truth to it, because the use of manipulative materials improves the performance among pupils in mathematics. Although the National Council of Teachers of Mathematics encourage the use of manipulative materials at all levels, Heddens (1997) cautions it must be used with care, else students are made to believe that two mathematical worlds exist; manipulative and symbolic. This research examines how manipulative materials are used in teaching mathematics with emphasis on Seikwa Central Circuit of the Tain district of Bono region.

Manipulative materials are virtual or physical objects and help students increase understanding of mathematical concepts (Boggan et al, 2011). Manipulative materials help students to learn mathematics meaningfully. They are suitable for students of all academic ability as well (Mcintosh, 2012). For mathematics to be easier and simpler for pupils to understand and improve their performance at the JHS level, the Ministry of Education (2012) recommended and promoted the use of manipulative materials as tools for instruction. The mathematics syllabus also emphasized and encouraged the use of manipulative materials during pre-service training. Despite the Ministry of Education initiatives, many Ghanaian mathematics teachers have remained reluctant to use any type of virtual or physical manipulative materials within their classroom instructional methods. They still use abstract and mental manipulative materials to teach mathematics.

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2. Materials and Methods

According to Sawsan and Raed, (2018) research design is a critical topic that is central to research studies in science, social science, and many other disciplines. Kassu (2019) posits that a very significant decision in research design process is the choice to be made regarding research approach since it determines how relevant information for a study will be obtained. Polit and Beck (2012) see research design as the overall plan of answering research questions. Gray et al (2014) suggests that research design sets the procedure on the required data, the methods to be applied to collect and analyze this data, and how all of this going to answer the research question. A cross-sectional design involves collecting data at one point and over a short period to provide a 'snapshot' of the outcome and the characteristics associated with a population at a specific time (Alhassan, 2012). The rationale for the adoption of a cross-sectional design is that it relies on large-scale data from a representative sample of a population with the aim of describing the nature of existing conditions. The study employed the descriptive research design and made use of quantitative methods of data collection and analysis to collect and analyze data to describe the phenomenon of examining the use of manipulative materials for teaching mathematics in the Seikwa Central Circuit of the Tain district of the Bono region of Ghana. Both primary and secondary data were collected to achieve the purpose of the study. Descriptive research is used to obtain information concerning the current status of a phenomenon to describe what exists with respect to variables or conditions in a situation.

Study population is a subset of the target population from which the sample is actually selected (Alex, 2014). Krieger (2012) defined population as all members of any well-defined class of people, events or objects. A population is the total number of units such as individual, artifacts, events and organization from which data can be collected (Parahoo, 2006). While Hayes (2011) defined target population as the entire population in which the researcher is interested and to which he or she would like to generalize the results of a study. In this study, the target population constituted 24 made up of fifteen (15) mathematics teachers and the nine (9) headteachers of the public schools in the circuit.

A sample is a subset of a larger group called population (Fink, 2003). Polit and Beck (2012) also see sample as a subset of a population selected to participate in a study. A sample can be seen, as a part of a whole population taken to take part in a study. Salkind (2010) emphasized that an appropriate sample size is necessary for any research because too small sample size is not good representative of the population. Too small sample size may lead to committing Type 1 error, which is the probability of wrongly rejecting a particular finding when it in fact to be accepted (Sekaran, 2013). Furthermore, Sekaran (2013) argued that too large sample size is not appropriate because of possible Type II error, which is accepting a particular finding when it is supposed to be rejected. A sample size of 24 participants made up of 15 (100%) mathematics teachers comprising 11(73.3%) males and 4(26.7%) females and 9(100%) headteachers of public schools were sampled for the study. That is all the mathematics teachers as well as the whole headteacher population of the public schools in the circuit were used for the study. This was in line with Alhassan (2012) assertion that, "the law of representation says that the larger the samples size the more representative it is in the population" (p. 72).

Sampling is taking a portion of the population of a study as a representation of the whole population (Seidu, 2015). Since researchers neither have time nor resources to analyze the entire population, they apply sampling technique to reduce the number of respondents (Hamed, 2016). The researcher sampled teachers from all the 9 public JHS in the Seikwa Central Circuit for the study to ensure the sample had fair representation of the population (Kusi, 2012). In the case of any school visited, the names of the mathematics teachers as well as headteacher were obtained from the headteachers. All the fifteen (15) mathematics teachers and nine (9) headteachers were selected for the study.

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According to Gumberg Library, research instrument is a tool used to collect, measure, and analyze data related to your subject. A research instrument is a tool used to collect data, or one that is designed to measure knowledge, attitude and skills (Parahoo, 2006). The study employed questionnaire as instrument for data collection. The main tool for gaining primary information in practical research is questionnaire due to the fact that the researcher can decide on the sample and the types of questions to be asked (Kassu, 2019 p2). According to Oxford Languages dictionary, questionnaire is a set of printed or written questions with a choice of answers, devised for the purposes of a survey or statistical study. A questionnaire is a research instrument consisting of a series of questions for the purposes of gathering information from respondents (McLeod, 2018). The researcher adopted questionnaire because a large number of respondents were covered and with little involvement of money, time and effort (Kusi, 2012).

The questionnaire consisted of items grouped in six sections namely: A, B, C, D, E and F. The items in section "A" were both open and close ended which was to obtain bio data of respondents. That is, their sex, age, qualification, period of teaching at the JHS, period of teaching mathematics at the JHS and period of being a headteacher in the case of headteachers. Section "B" contains 12 items, which consist of a four column table. Ghana Education Service approved topics, the type of manipulative materials approved for the topic, the materials teachers use to teach those topics, and their reasons for using those materials.Section "C" contained seven (7) items, which sough answers on how teachers obtained their manipulative materials for teaching mathematics at the JHS. It also sought answers on how often teachers receive/prepare the manipulative materials from the sources identified. Section "D" also contained two items on the teaching method used in teaching mathematics with the use of manipulative materials. Here also respondents were to select from lists of teaching methods suitable for teaching mathematics with manipulative materials at the JHS level and an open -ended questions seeking other methods used by these teachers. They were to also give reasons for using the method(s).

Section "E" contained eight (5) Likert-scale items to seek answers on the teachers' perceived benefits of using manipulative materials in teaching mathematics at the JHS level by ticking either Agree (1) or Disagree (2) or Uncertain (3). Section "F", which contained eleven (7) Likert-scale items seeking to collect data on the challenges of using manipulative materials in teaching mathematics by ticking either Agree (1) or Disagree (2) or Uncertain (3) and also, to provide other challenges of using manipulative materials but not in the items provided.

Questionnaires were designed and delivered to the respondents by the researcher in all the nine (9) JHSs in the Seikwa Central Circuit to obtain data from mathematics teachers as well as headteachers. Twenty-four (24) questionnaires were delivered to teachers and headteachers in the various schools. Two weeks duration was given to respondents to complete the questionnaires. The researcher called respondents frequently to remind them and after the two weeks period, the researcher then went round and collected the completed questionnaires from the teachers with the help of the head teacher at the various schools. The questionnaire items were carefully designed based on the research questions of the study. The variables were obtained through careful review of related literature and worded with both closed and open-ended questionnaire after the supervisor and other colleagues had proofread and scrutinized the questionnaires.

Data analysis is defined as a process of cleaning, transforming, and modeling data to discover useful information for business decision-making (Guru99.com). The purpose is to extract useful information from data and taking the decision based upon the data analysis (Guru99.com). The data analysis part answered the basic questions raised in the problem statement. In this study, a questionnaire that produced quantitative data was used. The quantitative data were analyzed using descriptive statistics.

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3. Results and Discussion

Table 1: Demographic Characteristics of teacher Respondents

Variables	Category	Percentage Head teachers	Percentage Teachers
Sex	Male	9(100)	11(73.3)
	Female	0	4(26.7)
	Sub-Total	**9(100)**	15(100)
Age	below 20yrs	0	0
	20-30yrs	0	9(60)
	31-40yrs	3(33.3)	6(40)
	41-50yrs	5(55.6)	0
	Above 50yrs	1(11.1)	0
	Sub-Total	**9(100)**	**15(100)**
Qualification	Diploma	0	6(40)
	First degree	8(90)	9(60)
	Masters	1(10)	0
	Other (specify)	0	0
	Sub-Total	**9(100)**	**15(100)**
Period as headteacher/ Teacher at JHS	Less than 5yrs	3(33.3)	7(60)
	5-10yrs	3(33.3)	4(26.7)
	11-15yrs	1(11.1)	2(13.3)
	16-20yrs	1(11.1)	2(13.3)
	Above 20yrs	1(11.1)	0
	Sub- Total	-	**15(100)**

From Table 1, all the 9(100%) headteachers in the circuit were males. The age distribution shows that, more than half 5(55.6%) of the headteacher population in the Circuit were between the ages of 41-50. None of the headteachers in the Circuit was between the ages below 31 years. The study again revealed that 3(33.3%) of the headteachers were between the ages of 31-40 years and One headteacher 1(11.1%) was above 50 years. The age statistics suggested that most of the JHS headteachers in the Seikwa Central Circuit were relatively old. Based on their highest qualification, 8(88.9%) of the headteacher respondents have first degree certificates in related fields while 1(11.1%) of the respondents has a Master's degree. None of them had Diploma or any other certificate. Again, the range of qualifications suggested that most of the headteachers in the Circuit have first degree.

On the part of teacher respondents, 11(73.3%) of the teacher respondents are males whilst 4(26.7%) are females. The age distribution shows that, 9(60%) of mathematics teachers in the Circuit were between the ages of 21-30 whilst 6(40%) were between 31-40 years. None of the mathematics teachers in the Circuit was below age 20 or above 40 years. Based on their highest qualification, 6(40%) of the mathematics teacher respondents have Diploma whilst 9(60%) have first degree certificates in related fields. None of them has Master's degree or any other certificate. Again, the range of qualifications suggested that most of the teachers in the Circuit have first degree. Headteachers' responses on the length of period of been head teachers and teacher response on the period they have taught mathematics was organized into a bar Chart as in Figure 1below:

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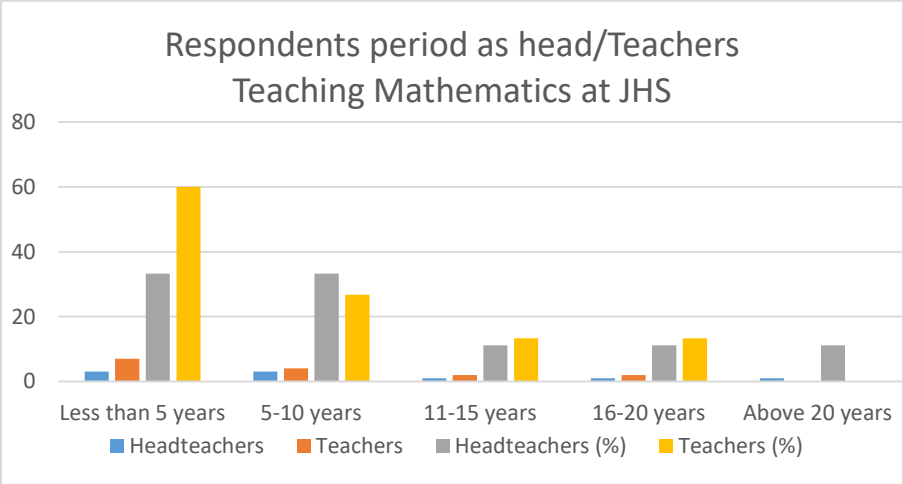

Figure 1: Respondents period as Head/teachers at JHS

The figure 1 above shows that, 3(33.3%) of the headteachers have taught in JHS for less than 5years. However, 3(33.3%) of respondents have taught for between 5-10years. Again, 1(11.1%) has taught for 11-15 years, 1(11.1%) for 16-20years and 1(11.1%) for more than 20years as headteacher The above bar graph shows the number of years teacher respondents have taught mathematics at JHS. From the graph above, 7(46.7%) have taught mathematics for less than 5 years, 4(26.7%) have taught mathematics between 5-10 years. Again, 2(13.3%) have taught it between 11-15 years, 2(13.3%) have taught mathematics for between 16-20 years. None of them has taught for more than 20 years.

Types of Manipulative Materials JHS Teachers Use in Teaching Mathematics in the Municipality

The purpose of this section is to identity the types of manipulative materials respondents' mathematics teachers use in teaching mathematics at the JHS level. The types of manipulative materials used by respondents were some of the approved materials by Ghana Education Service (GES). Respondents were to select those manipulative materials their mathematics teachers use in teaching mathematics. These were analyzed using frequency, rankings and percentages.

Table 2a: Manipulative materials JHS teachers use in teaching Numbers and Numerals, Sets, and Fractions

Topics	Types of Manipulative Materials	Headteacher Scores (%)	Teacher Scores (%)
Numbers and Numerals	Abacus	9(100)	10(66.7)
	Color coded	3(33.3)	3(20)
	Place value chart	8(88.9)	14(93.3)
	Counters	8(88.9)	7(46.7)
Sets	Stones	8(88.9)	12(80)
	Sticks	8(88.9)	10(66.7)
	Beans	6(66.7)	3(20)
	Maize	5(55.6)	5(33.3)
	Bottle tops	7(77.8)	13(86.7)
	Books	5(55.6)	6(40)

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	Pencils	7(77.8)	3(20)
	Pens	6(66.7)	5(33.3)
Fractions	Strips of paper	9(100)	13(86.7)
	Fraction charts	6(66.7)	2(13.3)
	Addition machine tape	2(22.2)	4(26.7)
	Cuisenaire rods	7(77.8)	6(40)
	Others	2(22.2)	2(13.3)

In Table 2a all the nine respondents 9(100%) were of the view that their mathematics teachers use abacus, 8(88.9%) each use place value chart and counters whiles 3(33.3%) use color coded to teach Numbers and Numerals. On the same Table 2a, for teacher respondents, majority 14(93.3%) of the respondents use place value chart manipulative materials in teaching numbers and numerals, 10(66.7%) use abacus, 7(46.7%) use counters whiles 3(20%) use color coded manipulative materials in teaching the topic. In teaching Sets, 8(88.9%) out of the nine respondents said their mathematics teachers use stones and sticks. Also, 7(77.8%) teachers use bottle tops and pencils, 6(66.7%) use beans and pens whiles 5(55.6%) use maize and books to teach sets of numbers. On the same Table 2a 13(86.7%) of mathematics teachers were of the view that they use bottle tops, 12(80%) use stones, 10(66.7%) use sticks, 6(40%) use books, 5(33.3%) use maize and pens whiles 3(20%) use pencils and beans to teach sets of numbers.

Again, all the nine respondents 9(100.0%) said that in teaching fractions, their teachers use strips of papers, 7(77.8%) use Cuisenaire rods, 6(66.7%) use fraction charts, and 2(22.2%) use addition machine tape. Also 2(22.2%) of the respondents said that their teachers use ropes and rectangular shapes to teach fractions. On the part of mathematics teachers on teaching fractions, 13(86.7%) out of the fifteen respondents said they use strips of paper. Less than half of the mathematics teachers use the other manipulative materials to teach the same topic. That is 6(40%) teachers use Cuisenaire rod, 4(26.7%) use addition machine whiles 2(13.3%) use fraction charts and number line to teach fraction. So this means that in teaching fraction, most mathematics teachers in the circuit use strips of papers possibly because it is easy to get.

Table 2 b: **Manipulative materials JHS teachers use in teaching capacity, time, money and mass, Angles, and properties of quadrilaterals**

Topics	**Types of Manipulative Material**	**Headteacher Score (%)**	**Teacher Score (%)**
Capacity, time, money and mass	Tea and table spoons	6(66.7)	9(66.7)
	Soft drink cans and bottles	9(100)	12(73.3)
	Bucket balance	6(66.7)	1(6.7)
	Measuring cylinders	4(44.4)	13(86.7)
	Jugs and scales	3(33.3)	6(40)
	Others (clock, cedi notes, coins)	4(44.4)	2(13.3)
Angles	Protractor	9(100)	15(100)
	Pair of compass	9(100)	15(100)
	Cut-out triangles	7(77.8)	6(40)
	Stones	3(33.3)	6(40)
	Threads	2(22.2)	2(13.3)
Properties of Quadrilaterals	Cut-out shapes	8(88.9)	15(100)
	Ruler	8(88.9)	14(93.3)

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Protractor	8(88.9)	13(86.7)

All the nine respondents 9(100%) were of the view that their mathematics teachers use soft drink cans and bottles to teach capacity, time, money and mass, 6(66.7%) of them use tea and table spoons and bucket balance, 4(44.4%) use measuring cylinder whiles 3(33.3%) use jugs and scales to teach capacity, time money and mass. In teaching capacity, time, money and mass, 13(86.7%) of the teachers were of the view that they use measuring cylinder to teach, 12(80%) of them use soft drink cans and bottles, 9(60%) use tea and table spoon, 6(40%) use jugs and scales, 1(6.7%) use bucket balance whiles 2(13.3%) use cedi note and coins.

In teaching Angles, all the 9(100%) of the respondents said their mathematics teachers use protractor and pair of compass. Also, 7(77.8%) teachers use cut-out triangles, 3(33.3%) use stones whiles 2(22.2%) use thread to teach angles according to headteacher respondents. In teaching angles on the part of teacher respondents, all the 15(100%) said they use protractor and pair of compass. Also, 6(40%) teachers use cut-out triangles and stones, 4(26.7%) use threads whiles 2(13.3%) use wall clock and ruler to teach angles. In teaching Properties of quadrilaterals, 8(88.9%) of respondents said that their mathematics teachers use cut out shapes, ruler and protractor to teach. This means that teachers in the circuit teach using all the three manipulative materials equally. For mathematics teacher respondents, in teaching Properties of quadrilaterals, all the 15(100%) said that they use cut out shapes, 14(93.3%) use ruler and 13(86.7%) use protractor to teach. This means that teachers in the circuit teach using all the three manipulative materials listed.

Table 2c: Manipulative materials JHS teachers use in teaching probability and vectors

Topics	**Types of Manipulative Material**	**Headteachers Scores (%)**	**Teachers Scores (%)**
Probability	Coins	9(100)	15(100)
	Dice	9(100)	15(100)
	Stones	5(55.6)	5(33.3)
Vectors	graph sheets	9(100)	15(100)
	Protractor	8(88.9)	15(100)
	Ruler	8(88.9)	13(86.7)

In teaching probability, all the nine 9(100%) of the headteachers said that their mathematics teachers use both coins and dice whiles 5(55.6%) use stones. According to mathematics teachers, all the 15(100%) said they use both coins and dice whilst 5(33.3) use stones. So the same number of teachers teaches probability using coins and dice. Also, all the nine 9(100%) of respondents said in teaching vectors, their teachers use graph sheets whilst 8(88.9%) of them said their mathematics teachers use both protractor and rulers. All the fifteen 15(100%) of the teachers said they use both graph sheet and protractor to teach vectors whiles 13(86.7%) use ruler. Headteacher respondents were asked why they use those selected manipulative materials to teach mathematics. Here are some of their responses:

> Headteacher 1 "***Place value and abacus are always available in the school office and teachers can lay their hands on them any time they want to use them to teach the topic numbers and numerals"***

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Headteacher 2 put it that: ***Using stones, pencils, pens, sticks to teach "set" make pupils to understand better, these materials are also easy to be obtained and they give clear visual ability making sorting easier***.

Headteacher 3 wrote: ***"Strips of papers and fractional charts are easy to be obtained and they facilitates teaching and learning and give a clear view of the fractions***"

Most of them said:

The materials are accessible, usable and cost effective. It can also be easily improvised.

How JHS Teachers Obtain their Manipulative Materials for the Teaching of Mathematics

Source of materials	Headteachers Scores (%)	Teachers Score (%)
Improvisation	9(100)	15(100)
Supply from MOE/GES	9(100)	15(100)
Donations from NGOs/Philanthropists	4(44.4)	8(53.3)
Tain district assembly	1(11.1)	7(46.7)
PTA/SMC	4(44.4)	10(66.7)

Table 3: How manipulative materials are obtained

Respondents were asked how their mathematics teachers obtain their manipulative materials for teaching mathematics in the circuit. All the 9(100%) said they do improvisation every term. The same number of respondents 9(100%) said they get supply from MOE/GES but 8(88.9%) said it comes once in a while whilst 1(11.1%) said it comes yearly. Again 4(44.4%) were of the view that they get some donations from NGOs and Philanthropists however it comes once a while but 6(66.7%) said they do not get any donation from any NGO/Philanthropist. Interestingly, on whether they get some teaching materials from the Tain district assembly, only 1(11.1%) said they get but once in a while whilst 8(88.9%) said there have not been any supply. Respondents were asked if PTA/SMC been stakeholders in education provide them with materials. In their responds, 4(44.4%) were in affirmative but said it comes once in a while whilst 5(55.6%) said there have not been any supply. This means most of the materials mathematics teachers use in the circuit is made by teachers and pupils themselves. Any other supplies come once a while. Respondents were asked what prevent them from obtaining the manipulative materials if no supply was made. Here are some of their responses:

"Inadequate capital is the reason why we cannot obtain them. Some of the materials are costly and are not easy to improvise". "Lack of funds or financial problems"

"Some materials cannot be easily improvised and the appropriate quarters are not supplying them too".

The same question was asked teacher respondents about how they obtain their manipulative materials.

All the 15(100%) said they do improvisation every term, 13(86.7%) said they get supply from MOE/GES but once in a while. Again 8(53.3%) were of the view that they get some donations from NGOs and Philanthropists yet it comes once a while but 7(46.7%) said they have not got any donation from any NGO/Philanthropist. On whether they get some teaching materials from the Tain district assembly, 7(46.7%) said they get but once in a while whiles 8(53.3%) said there have not been any

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supply. Respondents were asked if PTA/SMC been stakeholders in education provide them with materials. In their responds, 10(66.7%) were in affirmative but said it comes once in a while whiles 5(33.3%) said there have not been any supply. Respondents were asked what prevent them from obtaining the manipulative materials if no supply was made. Here are some of their responses:

> ***"Inadequate capital is the reason why we cannot obtain them. Some of the materials are costly and are not easy to improvise". "Lack of funds or financial problems"***
>
> ***"Some materials cannot be easily improvised and the appropriate quarters are not supplying them too".***

Teaching Methods JHS Teachers use for teaching mathematics in the circuit

Headteacher respondents were asked the type of method JHS Teachers use most for teaching mathematics in the circuit. The results are displayed below:

Type of Method	Headteachers Scores (%)	Teachers Scores (%)
Lecture method	4(44.4)	1(6.7)
Discussion method	5(55.6)	7(46.7)
Activity method	9(100)	13(86.7)
Problem solving	1(11.1)	1(6.7)
Role play	5(55.6)	2(13.3)
Group method	8(88.9)	7(46.7)
Others	3(33.3)	3(20)

Figure 4: Teaching Methods JHS Teachers use for teaching mathematics in the circuit

From the table above and graph below, all the 9(100%) headteachers responded that their mathematics teachers use activity method to teach mathematics more than the rest of the methods. Also 8(88.9%) said they use group method, 5(55.6%) use discussion and role play methods, 4(44.4%) use lecture method, 3(33.3%) use other materials which was not part of the methods used for the questionnaire. Lastly, 1(11.1%) use problem method. This means that most of their teachers do not teach using problem method.

From the graph above, most mathematics teachers responded that they use activity method to teach mathematics more than the rest of the method with 13(86.7%). Also 7(46.7%) said they use discussion and group method, 3(20%) use deductive method which was not part of the methods used for the questionnaire. Again, 2(13.3%) use role play method whiles 1(6.7%) use lecture and problem solving. This confirms the headteacher respondents' findings that their teachers do not teach using problem method.

Headteachers'/Teachers responses on teaching methods JHS teachers use for teaching mathematics were organized into a bar chart as in Figure 4.1below:

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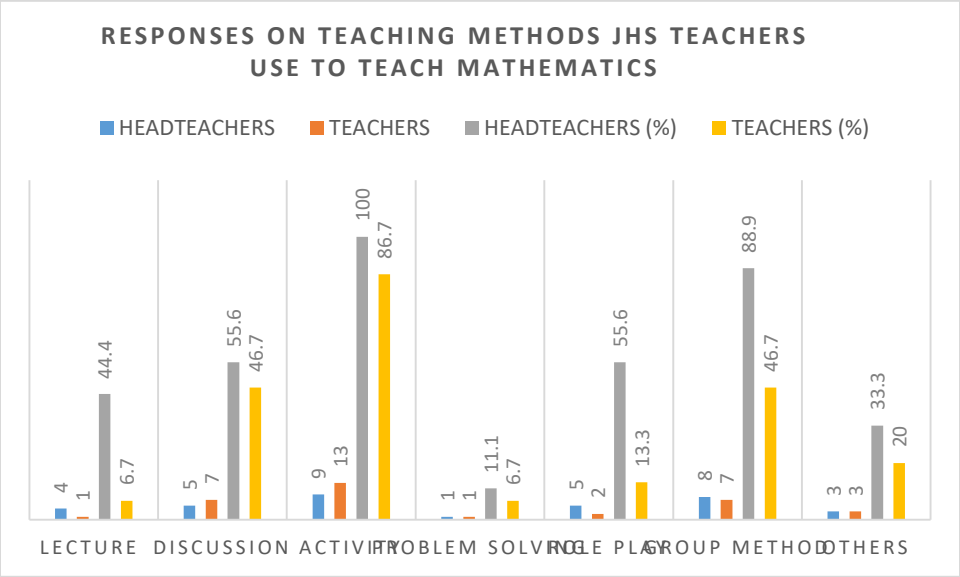

Figure 2: Teaching Methods JHS Teachers use for teaching mathematics

There was a question as why teachers use the methods they selected most when teaching the topics listed using the manipulative materials selected.

Here are some of their responses:

Headteacher 1: "Because activity and group methods are very effective and child centred"

Headteacher 2: "Activity method encourages learner active participation where he feels free to explore new ideas"

Headteacher 3: "Some teachers do not use TLMs to teach so use lecture method".

Headteacher 4: "Activity and group methods keep pupils busy in class, teacher only gives directions and pupils fill free working with their peers"

Teacher respondents were asked the same question as why they use the selected methods during mathematics lessons. Here are some of their responses:

"Activity methods help learners to explain their ideas". "Discussion method involves both the learner and the teacher". "Discussion method engages the teacher and the pupils".

Benefits of Using Manipulative Materials in Teaching Mathematics in the Circuit

Table 5: The Benefits of Using Manipulative materials for Mathematics Lessons in JHSs

Benefits of Using	**Headteachers Respondents (%)**			**Teacher Respondents (%)**		
Manipulative materials	**Agree**	**Disagree**	**Uncertain**	**Agree**	**Disagree**	**Uncertain**
It improves pupils	9(100%)	-	-	15(100)	-	-

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easy understanding and they can construct their own knowledge of the subject easily						
It saves a lot of time and more topics are easily covered	9(100%)	-	-	14(93.3)	-	1(6.7)
Pupils are motivated and their needs are attended to	9(100%)	-	-	15(100)	-	-
Pupils work cooperatively in solving Problems	9(100%)	-	-	14(93.3)	-	1(6.7)
It is fun and easy way to introduce a mathematical concept	9(100%)	-	-	14(93.3)	-	1(6.7)
Pupils to relate real world situations to Mathematics symbolism	4(44.4%)	-	5(55.6%)	14(93.3)	-	1(6.7)

Respondents were asked to indicate whether they agree, disagree or uncertain about some statements about the benefits of using manipulative materials to teach mathematics in the seikwa central circuit. All the 9(100%) agreed that it improves easy understanding and pupils can construct their own knowledge of the subject easily, it saves a lot of time and more topics are easily covered, pupils are motivated and their needs attended to when they use manipulative materials to teach mathematics, pupils work cooperatively in solving problems, and that it is fun and easy way to introduce a mathematical concept. Then 4(33.3%) of them said the use of manipulative materials make pupils relate real world situation to mathematical symbolism whilst 5(66.7%) were uncertain.

In the same way, all the 15(100%) teacher respondents said they agree that it improves easy understanding and pupils can construct their own knowledge of the subject easily. About the second statement, 14(93.3%) said they agree whilst 1(6.7%) was not certain that it saves a lot of time and more topics are easily covered. Again, all the 15(100%) were of the view that pupils are motivated and their needs attended to when they use manipulative materials to teach mathematics. Also 14(93.3%) of respondents were in agreement that pupils work cooperatively in solving problems whiles 1(6.7%) was uncertain. Furthermore, 14(93.3%) of respondents agreed whilst 1(6.7%) was uncertain that it is fun and easy way to introduce a mathematical concept. Then 14(93.3%) of them said the use of manipulative materials make pupils relate real world situation to mathematical symbolism whilst 1(6.7%) was uncertain.

Challenges of using manipulative materials in teaching mathematics in the Seikwa central circuit

Respondents were asked to indicate whether they agree, disagree or uncertain on some statements about the challenges of using manipulative materials to teach mathematics in the seikwa central circuit.

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Table 5: Headteachers response on the challenges in using manipulative materials in teaching Mathematics in the circuit

Challenges of Using	Headteachers Score (%)			Teachers Score (%)		
Manipulative materials	Agree	Disagree	Uncertain	Agree	Disagree	Uncertain
High cost of preparing some manipulative materials prevents teachers from using them in class	7(77.8)	2(22.2)	-	14(93.3)	1(6.7)	-
Time allocated for math's instruction is too short for teachers to use manipulative materials	7(77.8)	1(11.1)	1(11.1)	10(66.7)	5(33.3)	-
Large class size is the reason why your teachers do not use manipulative materials in class	7(77.8)	1(11.1)	1(11.1)	10(66.7)	1(6.7)	4(26.7)
Teachers work load prevents them from using manipulative materials to teach mathematics	2(22.2)	7(77.8)	-	4(26.7)	11(73.3)	-
Teachers do not have adequate user guides on the use of manipulative materials	2(22.2)	5(55.6)	2(22.2)	2(13.3)	13(86.7)	-
There is no continuous professional training for teachers as to the use of manipulative materials	4(44.4)	5(55.6)	-	10(66.7)	4(26.7)	1(6.7)
Non-availability & inadequacy of manipulative materials in schools	7(77.8)	2(22.2)	-	10(66.7)	1(6.7)	4(26.7)
Teachers do not have the knowledge of manipulative materials	2(22.2)	5(55.6)	1(11.1)	-	15(100)	-

On the statement that high cost of preparing some materials prevents teachers from using them in the class, 7(77.8%) of respondents agreed whilst 2(22.2%) disagreed. Also, 7(77.8%) of respondents agreed that time allocated for mathematics is too short for teachers to use manipulative materials, 1(11.1%) disagreed whilst 1(11.1%) was uncertain. Again, 7(77.8%) agreed that large class size is the reason why teachers don't use manipulative materials in class, 1(11.1%) disagreed whilst 1(11.1%) were uncertain. But on a statement that teachers workload prevent them from using manipulative materials to teach mathematics, 7(77.8%) disagreed with that, whilst 2(22.2%) agreed. On whether teachers do not have adequate user guides on the use of manipulative materials to teach mathematics, 5(55.6%) disagreed, 2(22.2%) agreed whilst 2(22.2%) were uncertain. On a statement that there is no continuous

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professional training for teachers as to the use of manipulative materials, 5(55.6%) disagreed, 2(22.2%) disagreed whilst 2(22.2%) were uncertain. Furthermore, 10(66.7%) agreed that non-availability and inadequacy of manipulative materials are the reasons why your teachers don't use manipulative materials in teaching mathematics, 7(77.8%) agreed whilst 2(22.2%) were not certain. Lastly, on the statement that mathematics teachers do not have the knowledge as to the use of manipulative materials, 1(11.1%) respondent agreed, 7(77.8%) disagreed whilst 1(11.1%) was not certain.

On the part of teacher respondents, the statement that high cost of preparing some materials prevents teachers from using them in the class, 14(93.3%) of respondents agreed whilst 1(6.7%) disagreed. Also, 10(66.7%) of respondents agreed that time allocated for mathematics is too short for teachers to use manipulative materials whilst 5(33.3%) disagreed. Again, 10(66.7%) agreed that large class size is the reason why teachers don't use manipulative materials in class, 1(6.7%) disagreed whilst 4(26.7%) were uncertain. But on a statement that teachers workload prevent them from using manipulative materials to teach mathematics, 11(73.3%) disagreed with that whilst 4(26.7%) agreed. Again, 13(86.7%) disagreed that teachers do not have adequate user guides on the use of manipulative materials to teach mathematics whilst 2(13.3%) agreed. On a statement that there is no continuous professional training for teachers as to the use of manipulative materials, 10(66.7%) agreed, 4(26.7%) disagreed whilst 1(6.7%) was uncertain. Furthermore, 10(66.7%) agreed that non-availability and inadequacy of manipulative materials are the reasons why your teachers don't use manipulative materials in teaching mathematics, 1(6.7%) disagreed whilst 4(26.7%) were not certain. Lastly, on the statement that mathematics teachers do not have the knowledge as to the use of manipulative materials, all the 15(100%) respondents disagreed.

4. Conclusion

Mathematics teachers in the Seikwa Central circuit are aware of the approved manipulative materials by MOE/GES and use them. Abacus came top, followed by place value chart and counters when teaching numbers and numerals, Stones, sticks and bottle tops are mostly use by teachers when teaching sets, whilst strips of paper came first when teaching fractions. Again, in teaching capacity, time, money and mass, soft drink cans and bottles came first according to both headteacher and teacher respondents. Protractor and a pair of compasses are used most when teaching angles, whilst cut-out shapes are used most when teaching properties of quadrilaterals. Lastly, coins and dice are used to teach probability and graph sheets and protractor for vectors. On how JHS teachers obtain manipulative materials when teaching mathematics, they both agree that mathematics teachers improvise most of the materials termly and also get supply from MOE/GES once a while. Very little come from NGOs, PTA/SMC and the Tain district assembly once in a while.

With the teaching methods JHS teachers use for teaching mathematics with manipulative materials, activity method is on top whiles problem solving and lecture methods come last. Also, on the benefits of using manipulative materials in teaching mathematics in the circuit, they both agree that it improves easy understanding and pupils can construct their own knowledge of the subject easily, it saves a lot of time and more topics are easily covered, pupils are motivated and their needs attended to when they use manipulative materials to teach mathematics, pupils work cooperatively in solving problems, and that it is fun and easy way to introduce a mathematical concept, with few of them saying they are not certain that the use of manipulative materials make pupils relate real world situation to mathematical symbolism. Lastly, the challenges in using manipulative materials are met with mixed feelings. They both agree that non-availability and inadequacy of manipulative materials and high cost of preparing some materials are the most serious challenges in using manipulative materials when teaching mathematics. They both disagree also that teachers workload prevent them from using manipulative materials, teachers do not have adequate user guides on the use of manipulative materials,

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and mathematics teachers do not have the knowledge as to how to use manipulative materials to teach mathematics.

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