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Students' performance on the Ghanaian junior high school mathematics national minimum standards in the Effutu Municipality

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Abstract

This study investigated Effutu Municipality Junior High School (JHS) 2 students' performance on the National Minimum Standards (NMS) set by the 2012 JHS revised mathematics syllabus. It specifically sought to find out whether the JHS 2 students in the Municipality will attain the NMS set by the end of basic education. The population was JHS 2 students in the Central Region in the 2013/2014 academic year. Ten JHS were randomly selected in the Effutu Municipal to participate in the study. A total of 285 students (141 males and 144 females) responded to test items based on the NMS. The study employed survey as a strategy of enquiry using a test designed following rigorous standard-test design principles. The test comprised a 35 item multiple choice items taken in 120 minutes. For easy interpretation, the students obtaining a mean score below 55% were categorized as 'performing below minimum standards', those scoring between 55% and 65% were categorized as performing at 'minimum competency' and those scoring of 65 and above were categorized as performing at proficiency level. The study revealed that eight out of the nineteen content standards (i.e. 42%) were found to be difficult by the students. It was found that overall about 30% of the students achieved the proficiency mean score of at least 65% and only about 10% achieved below the minimum competency level, implying about half of the students are operating at minimum competency level. The results also revealed that in the Effutu Municipality, students in private JHS outperform their counterparts in the public JHS as the results indicated that the majority of private school students (77%) achieved proficiency as compared to only 28% from the public schools. Recommendations are made for improving the performance of the students, particularly in public schools, who are not reaching proficiency.

Keywords national minimum standard, standard assessment test, students' achievement in mathematics, minimum content standards

Background

The importance of education is growing all over the world. The relationship between education and development, as well as the role of education in social inclusion and civil participation is increasingly evident (MOES, 2004). Education is being appreciated as never before, both as a human right and as a factor for development and collective achievement of higher levels of civilization. Within such framework, mathematics and science education is of primary importance due to our increasingly interdependent global economy, as well as to the globalized labor market and the technological developments that characterize our era and the near future.

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Onivehu and Ziggah (2004) asserted that "no nation can attain any technological breakthrough without well planned and effectively implemented mathematics education programme, since mathematics plays a leading role in all aspect of human endeavor". P.39. Mathematics is a key ability in the teaching of virtually every discipline. However, in Ghana, most students lack the ability to solve problems even with basic algorithms, and are unable to perform direct reasoning (Mereku, 2012a).

As defined by the OECD's Program for International Student Assessment (PISA),mathematical literacy is an individual's ability to identify and comprehend with the role that mathematics plays in the world, to make well-founded judgments and to use and engage with mathematics in ways that meet the needs of that individual's life as a constructive, concerned and reflective citizen (PISA, 2004).

Major concerns have been raised by parents, government, policy makers, and stakeholders in education about the nature of the Ghanaian curriculum and provision of education as a whole in this country.

To compete successfully in the worldwide economy, today's students must have a high degree of comprehension in mathematics. For too long have we, suffered from the notion that success in mathematics is the province of the talented few. Instead, a new expectation is needed, all students must be given the opportunity to attain at least minimum mathematics content standards, and many should be inspired to achieve far beyond the minimum standards (CRDD, 2012). According to the 2012 mathematics syllabus for JHS in Ghana, in order to achieve the general aims of the mathematics curriculum, teachers must provide opportunities for children to realize the specific minimum objectives which are the National Minimum Standards (NMS).These content standards establish what every student in Ghana can and needs to learn in mathematics. These standards are based on the premise that not all students are capable of learning rigorous mathematics and learning it well, and all are capable of learning far more than is currently expected.

Literature Review

Forms of Assessment used in Ghana

Assessment is in various forms for various grade levels in Ghana. In Ghana, apart from class room assessment, popularly known as the School Based Assessment (SBA), the various grade levels do not have external assessment scheme that evaluate students' performance and achievement termly or yearly. However, at every terminal point there is a national examination conducted for all students, the BECE at the end of JHS 3 (Grade 9) and the WASSCE which comes at the end of SHS 3 (Grade 12). Other forms of assessment in Ghana, according to a World Bank report are national large scale assessments (NEA, EGRA and EGMA) and international large scale assessments (TIMSS) (The World Bank, 2013). TIMSS is an international exam organized for grade 8 students in Mathematics and Science among some selected countries across the world. EGRA and EGMA are early grade reading and mathematics assessment for grade 2 pupils in Ghana. The purpose of these assessments are to provide policy-level information regarding class achievement and system performance (MOE, 2014a, 2014b).

Students' Achievement in Mathematics

In Ghana students' performances in mathematics as attested to by various reports from national large scale assessments (NEA, EGRA and EGMA), national examinations (BECE and WASSCE) and international large scale assessments (TIMSS), indicate that the performance of Ghanaian students in numeracy over the years is quiet low (Mereku, 2012) or leaves much to be desired. According to Anamuah-Mensah, Mereku and Asabere-Ameyaw (2004), the overall performance of students from the Ghana on the TIMSS 2003 mathematics tests was very low. Ghana obtained low mean scale scores of 276 in mathematics, placing the nation last but one of the overall results (i.e. placing 45th out of 46 participating countries). According to the TIMSS 2003 report, as cited in Anamuah-Mensah, Mereku and Asabere-Ameyaw (2004), compared to other African countries that took part in the examination, the performance of Ghana was one of the lowest. They argued that the Ghanaian students' inability to reach the higher benchmarks calls for the need to assist students to build a sound grounding in the mastery of basic knowledge and skills needed to solve more cognitively demanding problems. For the 2007 TIMSS, they reported that there had been a little improvement in mathematics achievement and yet Ghana's performance remained low by comparison to the quality of mathematics and education in other countries surveyed in the TIMSS. Anamuah-Mensah, Mereku & Ghartey-Ampiah, (2008) reported that there was a large variation in the Ghanaian students' mathematical abilities with the lowest obtaining a scale score as low as 130 and the highest obtaining a scale score as high as 430 which were all below the average scale score of 500 and maximum of 800 over the examination.

The issue of gender and mathematics achievement has been analyzed by many authorities in numerous research works. The argument has mostly shifted in favour of the males. However, some significant improvement has been made over the past few years in terms of female participation and achievement in mathematics.

According to a report by Anamuah-Mensah, Mereku and Asabere-Ameyaw (2004) on Ghana's participation in TIMSS 2003, Ghana was among countries where boys had significantly higher achievement than girls. They also report that, although both boys and girls improved on their performance in 2007 TIMSS as against the 2003 performance, boys again outperformed girls in all the content areas as well as cognitive domains (Anamuah-Mensah, Mereku & Ghartey-Ampiah, 2008). This is also corroborated by Etsey (2009) who reported in a research on academic performance within the urban-rural divide in Ghana, that boys performed better than girls in mathematics in both primary 3 and 6. It is clearly evident that female students' achievement in mathematics is still relatively low as compared to males. It is therefore important to create avenues and support females to realize their potential and see mathematics as a subject for everybody.

Minimum Content Standards

In order to investigate students' performance on the national minimum standard objectives, it is imperative to understand the meaning of standards in general and the essence of using them as a basis for instruction and assessment. The learning of mathematics at all levels involves more than just the basic acquisition of concepts and skills. It involves, more importantly, an understanding of the underlying mathematical thinking, general strategies of problem solving,

to site but few. Besides, the Mathematics syllabus for Ghanaian JHS pointed out the two categories of students the syllabus covers when it stated

> *"… The strong mathematical competencies developed at the JHS level are necessary requirements for effective study in mathematics, science, commerce, industry and a host of other professions and vocations for pupils terminating their education at the JHS level as well as for those continuing into tertiary education and beyond"… (MOE, 2012, p. iii).*

As a result of the importance and enormous benefits of mathematics most countries have set curriculum standards and tests for their students and developed assessments to monitor the implementation of those standards. According to Tienken & Wilson (2001), standards define what students should understand and be able to do in their study of mathematics. Standards-based programs are those written specifically to fulfill not only the content standards but also the pedagogical approaches that the standards advocate (Kirk, 2006).

It is in light of these "essential content for all" that the 2012 mathematics syllabus for Junior High Schools in Ghana has introduced the National Minimum Standards (NMS) for JHS (MOE, 2012). The introduction of the NMS is not an attempt to relegate other contents to the background nor to offer teachers the opportunity to excuse themselves from not completing the syllabus but to ensure that all students acquire the basic essentials in the content at each grade level.

Methodology

A survey design in test items was employed to address the research questions since the aim of the research was to design a test that will measure JHS 2 students' achievement on the mathematics National Minimum Standards. The population consisted of JHS 2 students in the 2013/2014 academic year in the Effutu Municipality of the Central Region in Ghana. The researcher selected this population because the study was focused on identifying students' achievement levels on the National Minimum Standards set all JHS students across the country. Again, the researcher works in the district, which is highly typical of districts in Ghana in terms of educational provisions.

Ten JHS were randomly selected in the Effutu Municipal to participate in the study. A total of 285 students (141 males and 144 females) in Form 2 (i.e. Year 8) were sampled to respondd to test items based on the NMS. The researcher employed the stratified/convenience sampling techniques to ensure the sample is representative of the key factors considered comprising school type (i.e. public or private), school location (i.e. rural or urban) and gender. The study employed survey as a strategy of enquiry using a test designed following rigorous standard-test design principles. The test comprised a 35 item multiple choice items taken in 120 minutes.

All respondents were assured of confidentiality both in written and verbal forms. As a precautionary measure, participants were not made to write their names on the answer sheet. Participants were also assured of confidentiality and anonymity of their answers and the information they provided for the research.

Results

The overall performance of students on the national minimum standards assessment test (NMSAT)

The overall mean score of students' responses on the test items were computed. The test comprised 35 items and the proportion of students obtaining correct responses on each item was also analyzed. A mean value below 55% indicates a low level of performance and a mean value above 65% indicates a high level of performance. Table 3 shows the overall mean score of students on the test items. The scores were further organized into maximum and minimum values and the results presented in the table. Table 3 presents the descriptive statistics of students' scores.

Table 3 Descriptive Statistics on the Total Score of Students

	(n)	Minimum Score	Maximum Score	Mean	Std. Deviation
Percentage Total Score	285	14	89	57.26	18.20

The students' average percent correct score on all 35 (100%) was 57% with a standard deviation 18%. This indicates a generally average performance by the students. However, the standard deviation is an indication that the mean is not a true representative of the performance of students since a sizeable number of students scored very low marks. The examination of the scoring pattern of the students showed a wide variation in their performance. As presented in the table, the range of scores as indicated by the minimum and maximum is from 5 (14%) to 31 (89%) was 26 (75%) which shows how diverse the JHS2 students were in their mathematics abilities. Table 4 shows the percentages of students performing above or below particular points on the achievement scale (i.e. from the 5th to 95th percentiles).

Table 4 Percentiles of Achievement on the NMS

5th Percentile	10th Percentile	25th Percentile	50th Percentile	75th Percentile	90th Percentile	95th Percentile
28.6	31.4	42.9	57.1	71.4	80.0	85.7

The 5th percentile indicates the lowest limit where the bottom five percent of JHS2 students achieved scores below 30%. The 95th percentile is the highest limit where only the top five percent of JHS2 students achieved a percentage score above 80%. Twenty-five percent of JHS2 students achieved percentage scores below 45% (25th percentile).

Content standards students find difficult to learn

Since the test is a minimum standard test, an average percentage score below 55% indicates that students are performing at minimum competency on such standards. Table 5 presents some

of the content standards that are not being achieved by students (or students find difficult to learn) and the proportion of students reaching these standard.

Table 5 Standards most students find difficult to attain in each of the five content domains

Content domain		Standards specified by syllabus objective	Percent reaching standard	Difficulty ranking
Number operations and Algebra	1.	Identify and use the appropriate operations (including combinations of operations) to solve word problems involving numbers and quantities, and explain methods and reasoning.	47.55	5
	2.	Write common fractions which are multiples of halves, fourths, fifths, and tenths as percentages and convert it to its simplest form (and vice versa).	32.46	1
	3.	Compare and order common rational numbers expressed as (common fractions, decimals and percentages).	47.37	4
	4.	Add and subtract fractions where the denominator of one is a factor of the other (e.g. $\frac{3}{4}+\frac{7}{8}, \frac{2}{5}-\frac{3}{10}$).	49.22	7
	5.	Carry out short multiplication and division of numbers involving decimals.	42.81	3
Measures, Shape and Space	6.	Bisect a given line segment and an angle and measure the result.	49.99	8
	7.	Find the perimeter and area of simple shapes drawn in square grid or draw such shapes when given the perimeter and area.	37.89	2
Problem Solving Applications	8.	Perform simple computation using the calculator as well as use it to check answers.	48.49	6

Results from Table 5 show that a number of the standards have not been achieved by majority of JHS 2 students. From the results only about 47.55% of students could solve simple word problems with a majority (52.45%) not achieving standard 1. On standard 2, only 32.46% of the students could write and convert, to its simplest form, common fractions as percentages. Only 47.37%, 49.22% and 42.81% of students could compare and order common rational numbers expressed as fractions, decimals and percentages, add and subtract fractions, and perform short multiplication and division of numbers involving decimals respectively. Furthermore, only about 49.99% could bisect and measure a line segment and an angle, 37.89% could find the perimeter and area of simple shapes leaving a majority (62.11%) who could not. Finally, only 48.49% were able to perform simple computations. These results show that a large number of students are yet to grasp some of the minimum content standards that every student is expected to acquire upon completing JHS.

Performance of students in various content domains

Figure 1 shows differences between average performance in each content domain and the overall average across content domains.

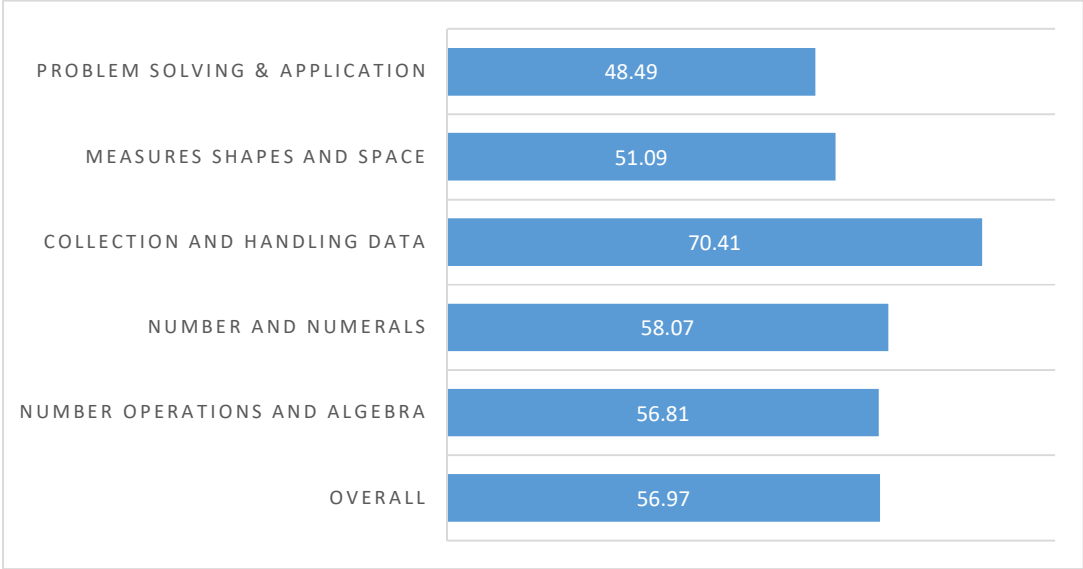

Figure 1 **Average percentage score on items in the content domains**

It can be seen from Figure 1 that students performed relatively better in Collection and Handling Data than the expected NMS average of 70%. They obtained an average scores 70.41% out of 3 items just above the 70% average in Collection and Handling Data. Their performance in Number Operations and Algebra, Number and numerals, and Measures Shape and Space was above 50% though below 70% but performed relatively lower in Problem Solving and Application. They obtained 48.49% score which is way below the expected average in Problem Solving and Application.

Performance of students in various cognitive domains

Figure 2 illustrates differences between percent average performance in each mathematics cognitive domain and the overall average across cognitive domains.

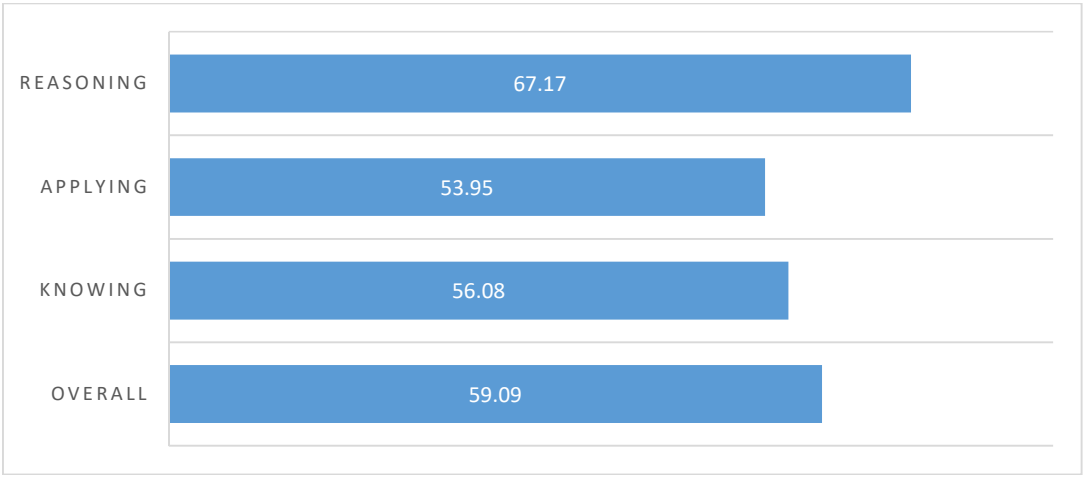

Figure 2 **Average percentage score on items in cognitive domains**

Figure 2 indicates that the performance was fairly good although none of the domains reached the expected average of 70% in each of the cognitive categories. Again, it can be seen from Figure 4.2 that their performance in reasoning was a little above the overall average but their performance was relatively lower in applying. A lower percentage of students (53.95) was able to answer questions in the applying domain, however, this domain contributed the chunk of the items (see Table 2).

Discussion

In this research, the researcher sought to find out students performances on the National Minimum Standard Objectives as provided by the 2012 mathematics syllabus for Ghanaian Junior High Schools. The researcher, in line with the standards, constructed test items that all JHS 2 students are expected to know, (CRDD, 2012). Thirty five (35) items were set to gather information on students' achievement on the NMS test. The focus was on students attaining a score not less than 55% or better still 70% of the test.

The analysis showed that about 70% of the students achieved scores below the 70% expected mark with just above 50% of the students achieving 55% and above; NEA pass mark. The overall mean performance of 20.02 (57.26%) shows an underachievement by students. From the quantitative analysis of students' general performance on the items, one can conclude that majority of the students just about sitting for the Basic Education Certificate Examination (BECE) lack basic concepts in mathematics needed for everyday life as most of the students performed poorly on the items.

On the findings of students' performance on the content domains, students recorded low performances in all the domains except handling of data where they achieved above 70%. Their weakest performance on the domains was seen in problem solving and application. This raises a lot of concerns especially when the Ghanaian Mathematics curriculum makes it clear, the importance of problem solving as an integral part of all mathematics content domains.

From the analysis of students' performance on the cognitive domains, students failed to make the 70% mark in all three domains; knowing, applying and reasoning. They recorded their weakest performance in applying. This finding is consistent with the finding of TIMSS 2007 where Ghanaian students' worst performances were recorded in applying. Also, the finding is in consonance with TIMSS 2011 where Ghanaian students achieved their lowest score in applying. This is worrying since the prime focus of mathematics education is for students to be able to apply mathematics concepts in various aspects of life and in learning other subjects. The rationale of the 2012 mathematics syllabus for Ghanaian Junior High School states clear that "with the knowledge and skills acquired in mathematics, pupils will discover, adapt, modify and be innovative in facing changes and future challenges" (CRDD 2012, p. iii). That is to say that learning of mathematics does not only involve the acquisition of basic concepts and skills, but also the understanding of the underlying mathematical thinking, and general strategies of problem solving. It is even more important to note that developing, at the J.H.S. level, strong mathematical abilities are essential requirements for effective study in mathematics, and other disciplines such as the sciences and a major requirement for numerous professions for individuals who may not be able to continue their education after the JHS level as well as for those who will get the opportunity to continue into tertiary education and beyond (CRDD,

2012).It therefore behooves on all JHS mathematics teachers to duel more on questions that require students to apply concepts learned in solving other mathematics problems.

Conclusion

The use of minimum standards as an assessment tool has helped identify various weakness in the both students' and teachers' performances in some Ghanaian junior high schools. The findings from the analyses indicated that about half of JHS students in Effutu have not achieved the minimum standard objectives as demanded by the mathematics syllabus. This showed that although the students have apparently learned mathematics from JHS1 to JHS2, in reality they have not grasped the essential elements in the subject required to cope with the mathematics demands of everyday life.

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