A Study on the Performance of Primary Six Pupils on Multiple Representations Strand of Number Sense in Gombe State

Aishatu Abubakar & Imande T. Terlumun
Mathematics Department
Federal College of Education (Technical), Gombe.
imanditerlumun@yahoo.co.uk

Abstract
The purpose of this study is to investigate the number sense performance of primary school pupils in Multiple Representations Strand of Number Sense among Primary Six Pupils in Gombe State. A descriptive survey design was used to collect data. A total of three hundred and ninety six (396) primary six pupils participated in the study (197male and 199female). That is eighteen pupils from each of the selected schools participated in the study. The instrument for data collection was fifteen item test on three forms of multiple representations (contextual, graphical and symbolic). Three research questions and three null hypotheses were raised. The data collected was analyzed by mean, percentage, standard deviation and t- test. Findings show that the pupils in this study have very low number sense in the three forms of multiple representations strand of number sense. Also found in this study was that all the three null hypotheses were rejected. It was recommended among other that teachers should help pupils to develop number sense by using multiple solution strategies in their classroom instructions in mathematics lessons.

Introduction

Learning the meaning of numbers and how they may be represented, relationship among them and computations with them are central to the developing number sense (Singh, 2009). The aim of mathematical education in school is that students can develop their mathematical thinking abilities and use them in their daily lives (Sengul & Gulbagci, 2012). Studies have shown that students' mathematical foundation is usually developed during their elementary years, where they are expected to acquire the basic and essential critical thinking and reasoning skills in order to solve challenging problems effectively (Falcum & Nool 2012). According to Ghazali (2004), students experiences related to the learning of number concept at the primary school level are important in developing the beliefs and values that they associate with mathematics. Meaningful experience will lead to the attainment of positive attitudes, values and beliefs about number concepts. According to Lassa & Palling (1983), primary school mathematics contents places greater emphasis on helping children to think for themselves and to learn through their own activities.

The traditional goals of primary school mathematics are the development of basic knowledge of addition and multiplication facts and the skills of paper-and pencil addition, subtraction, multiplication and division, which are usually developed as series of rote-learned rules for each operation which may lead to misconception, forgetfulness and the inability to use and adapt these procedures flexibly to the requirement of everyday real-life situations resulting in the general attitude towards mathematics as a subject dominated by memorisation of facts and rules (Beswick, Muir & McIntosh, 2004). Howden (1989) describe number sense as good intuition about numbers and their relationship that develops gradually and varies as a result of exploring numbers and visualising them in a variety of contexts, and relating them in ways that are not

limited by traditional algorithm. Furthermore, research studies have shown that children in elementary and middle grades are lacking number sense due to traditional mathematical teaching which over emphasises standard written algorithm (Menon, 2004). Students rarely have problem when performing algorithm but have problems when it comes to understanding the meaning of numbers and operations, relative size of numbers and recognizing the effect of operations on numbers.

McIntosh, Reys & Reys (1992) developed a frame work for examining basic number sense. From the framework six major components were identified of which understanding and use of equivalent representation of numbers (multiple representations) is among the components. Multiple representations refers to the recognition that numbers take many different forms of representations such as pictorial representations, symbolic representations and others to solve problems flexibly and appropriately under different situations (Ghazali, 2004). For example in representing $\frac{3}{4}$ in terms of various given representations student should understand that not only that $\frac{3}{4}$, $\frac{75}{100}$, 0.75, and 75% are all representation of the same number but such representation may not be equally suitable to use in a particular context. Thus this study is on the performance of primary school pupils on multiple representations strand of number sense.

Statement of the Problem

The main concern for most mathematics educators is that many students demonstrate little understanding of numerical situations in instances where they have to solve number problems. Several researches studies have focused on ways of improving students' performance in mathematics, yet the poor performance still exists. However little or no emphasis has been laid on number sense of students in mathematics which according to (Naukushu, 2011) is among the reasons for poor performance of students in mathematics. Thus, this study investigated the performance of primary school pupils in multiple representations strand of number sense in Gombe State.

Purpose of the Study

The main purpose of the study is to explore the performance of primary school pupils in multiple representations strand of number sense. Specifically the study seeks to achieve the following objectives:

(i) To determine the performance of primary six pupils in graphical representations of multiple representations strand of number sense.

(ii) To determine the performance of primary six pupils in contextual representations of multiple representations strand of number sense.

(iii) To determine the performance of primary six pupils in symbolic representations of multiple representations strand of number sense.

Research Questions

The following questions were formulated to guide the study:

(1) What is the performance of primary six pupils in graphical representations of multiple representations strand of number sense?

(2) What is the performance of primary six pupils in contextual representations of multiple representations strand of number sense?

(3) What is the performance of primary six pupils in symbolic representations of multiple representations strand of number sense?

Hypotheses

The following null hypotheses were tested at $\propto = 0.05$

H_{01}: There is no significant difference between the mean scores of primary six pupils in graphical representations and contextual representations of multiple representations strand of number sense.

H_{02}: There is no significant difference between the mean scores of primary six pupils in graphical representations and symbolic representations of multiple representations strand of number sense.

H_{03}: There is no significant difference between the mean scores of primary six pupils in contextual representations and symbolic representations of multiple representations strand of number sense.

Methodology

The study utilised descriptive survey research design. Survey research involves the collection of information from a sample of individuals through their response to questions. The study was conducted in Gombe state of Nigeria. The population of this study was all the primary six pupils from public primary schools in Gombe state. From each of the eleven local government areas in the state, two schools and eighteen pupils were randomly selected as sample for the study.

The instrument used for data collection was a 15-item paper and pencil Number Sense Test (NST) on multiple representations strand of number sense. The NST items were drawn from three parts of multiple representations as follows: five items from graphic representations (diagrams), five items from symbolic representations, and five items from contextual representations. The test items were adapted from a number sense test items bank from (McIntosh, Reys, Reys, Bana, & Farrell 1997). In each of the test items one is given for correct answer while zero score was awarded for an incorrect answer.

In order to establish the reliability of the instrument used in this study, a pilot study was conducted by the researcher. Twenty items was administered to one hundred randomly selected primary six pupils from four schools outside the sample. Five items were dropped after the item analysis. Using the scores obtained from the instrument administered to the pupils on the remaining fifteen items, the reliability coefficient of 0.71was found using K-R20.The Number Sense Test (NST) was administered by the researcher in each of the selected schools to the participants firstly by reading the instruction to them and then each item was read one at a time and a minute was given for them to answer before the next item is read.

Data Analysis

The test was scored on the basis of one mark was awarded for correct response and zero for incorrect response. Items not responded to by the pupils were not used in the analysis. The levels of number sense were studied and each item was ranked on which level of number sense it was using the descriptions as adopted from McIntosh, Reys, and Reys (1992) as follows: very strong number sense: for a score from 60% and above in the NST; Strong number sense: for a score from 50%to 59% in NST; weak number sense: for a score from 30% to 49% in NST and very weak number sense: for a score below 30% in NST. Thereafter, percentage, mean, standard deviation were used to answer the research questions, while t-test was used to test the null hypotheses at 0.05 level of significance (using SPSS version 16.0).

Results

Research Question one.

What is the performance of primary six pupils in graphical representations of multiple representation strand of number sense?

Table1: Descriptive Results of Pupils' Performance in Graphical representation.

Item number	Scores on items	Mean(percentage)	SD	Decision
1	84	0.22 (21.6)	0.41	Very low
2	44	0.12 (11.7)	0.32	Very low
3	133	0.34 (34.3)	0.47	Low
4	137	0.37 (37.1)	0.48	Low
5	71	0.18 (18.3)	0.39	Very low
Grand Mean	0.246			

The data in table 1 revealed the performance of primary six pupils in graphical representations of multiple representations strand of number sense as very low in three of the five items with a grand mean of 0.246. The highest mean of 0.37 in item 4 and the least mean of 0.12 in item 2.

Research Question Two.

What is the performance of primary six pupils in contextual representations of multiple representations strand of number sense?

Table 2: Descriptive Results of Pupils' Performance in Contextual Representations

Item number	Scores on items	Mean(percentage)	SD	Decision
6	76	0.20 (20.1)	0.40	Very low
7	144	0.37 (37.4)	0.48	Low
8	140	0.37 (36.9)	0.48	Low
9	244	0.65 (65.2)	0.48	Strong
10	172	0.45 (44.7)	0.50	Low
Grand Mean	0.40			

The data in table 2 revealed a low number sense in three of the five items in contextual representations and a strong number sense in item 9 with a mean of 0.65. Only 76 pupils got item 6 correct with a very low mean of 0.20. The grand mean of 0.408 indicated a low performance in the items in this category.

Research Question Three.

What is the performance of primary six pupils in symbolic representations of multiple representations strand of number sense?

Table 3: Descriptive Results of Pupils' Performance in Symbolic Representations.

Item Number	Scores on Items	Mean (Percentage)	SD	Decision
11	106	0.29 (28.6)	0.45	Very low
12	70	0.19 (19.2)	0.39	Very low
13	44	0.12 (12.1)	0.33	Very low
14	67	0.18 (17.9)	0.38	Very low
15	59	0.16 (16.3)	0.37	Very low
Grand Mean	0.188			

The results in Table 3 revealed that the pupils have a very low number sense in all the items in symbolic representations with a grand mean of 0.188. The highest mean of 0.29 is in item 11 and the least mean of 0.12 is in item 13.

Hypothesis One.
There is no significant difference between the mean performance of primary six pupils in graphical and contextual representations of multiple representations strand of number sense.

Table 4: t- test analysis of the difference between the mean performance of pupils in graphical and contextual representations

Item type	n	mean	Std Dev	Df	t_{cal}	P	Decision
graphical	396	1.1843	0.92987	790	10.805	0.000	Rejected
contextual	396	1.9520	1.06508				

The data in Table 4 revealed that the pupils mean score in graphical representations is 1.1843 with standard deviation of 0.92987 while their mean score in contextual representations is 1.9520 with standard deviation of 0.06508. Also t = 10.805, P = 0.000 for df = 790 at $\alpha = 0.05$. Since P –value is less then alpha,(i.e $p<0.05$) the null hypothesis Ho_1 is rejected at 0.05 level of significant and therefore conclude that there is significant difference between the mean performance of pupils in graphical and contextual representations in the number sense test. That is the mean performance of pupils in graphical representations differs from that of contextual representations.

Hypothesis Two
There is no significant difference between the mean performance of primary six pupils in graphical and symbolic representations of multiple representations strand of number sense.

Table 5: t- test of the difference between the mean performance of pupils in graphical and symbolic representations.

Item type	n	mean	Std Dev	Df	t_{cal}	P	Decision
Graphical	396	1.1843	0.92987				

				788	4.916	0.000	Rejected
Symbolic	394	0.8782	0.81673				

Table 5 revealed that the pupils mean score in graphical representations is 1.1843 with standard deviation of 0.92987 while their mean score in symbolic representations is 0.8782 with standard deviation of 0.81673. Also t = 4.916, P = 0.000 for df = 788 at α = 0.05. Since P – value is less then alpha,(i.e p<0.05) the null hypothesis Ho_2 is rejected at 0.05 level of significant and therefore conclude that there is significant difference between the mean performance of pupils in graphical and symbolic representations in the number sense test. That is the mean performance of pupils in graphical representations differs from that of symbolic representations.

Hypothesis Three

There is no significant difference between the mean performance of primary six pupils in contextual and symbolic representations of multiple representations strand of number sense.

Table 6: t- test analysis of the difference between the mean performance of pupils in contextual and symbolic representations.

Item type	n	Mean	Std Dev	Df	t_{cal}	P	Decision
Contextual	396	1.9520	1.06508				
				788	15.896	0.000	Rejected
Symbolic	394	0.8782	0.81673				

The data in Table 6 revealed that the pupils mean score in contextual representations is 1.9520 with standard deviation of 0.06508, while their mean score in symbolic representations is 0.8782 with standard deviation of 0.81673. Also t = 15.896, P = 0.000 for df = 788 at α = 0.05. Since P –value is less then alpha,(i.e p<0.05) the null hypothesis Ho_3 is rejected at 0.05 level of significant and therefore conclude that there is significant difference between the mean performance of pupils in contextual and symbolic representations in the number sense test. That is the mean performance of pupils in contextual representations differs from that of symbolic representations.

Discussion of Findings

It was evident from the data collected that primary six pupils in Gombe state have very low number sense. A similar situation was found when Facum and Nool (2012) conducted a study on grade six pupils in Tarlic city, Philippines. The findings of their research revealed that the pupils have poor number sense. Also Akkaya (2016) found that multiple representations component as the most difficult among secondary school students with only 16.9% correct response of number sense test. The data in Table 1 revealed the result of the five items written in graphical representations. Very low number sense was recorded for items 1, 2, and 5, and low number sense for items 3and 4. Incorrect response to item 1 highlight lack of a bench mark with which to compare and make judgement about the fraction $\frac{1}{3}$. which shows lack of understanding of the relationship between $\frac{1}{4}$ and $\frac{1}{3}$. The representation of a shaded area as a decimal was worse answered by the pupils (item 2). Only 44 pupils choose the correct option with a mean of 0.12.The performance of pupils in graphical representations is very low with a grand mean of the items as 0.246 which indicates that the pupils in this research cannot interpret question written in graphical form. This is in agreement with Purnomo, Kowiyah, Alyani & Assiti (2014) that most students saw the concept of fraction by counting the shaded part as the

numerator and the whole part as the denominator without considering if the size of each part was equal.

Table 2 revealed the performance of pupils in contextual representations of multiple representations strand of number sense. Surprisingly the pupils in this study have generally fared better in contextual representations items than graphical and symbolic representations with a grand mean of 0.408 while that of graphical and symbolic representations are 0.246 and 0.188 respectively.

The performance of pupils in symbolic representations in Table 3 was worse answered by the pupils with very low numbers sense in all the five items with a grand mean of 0.188. In item12 which asked the pupils: which statement is true about the number $\frac{2}{5}$? About 19% of the pupils were able to choose the correct option. The majority of the pupils' response was 2.5, which is a clear indication that pupils lack the concept of fractions. Also in representing the fraction $\frac{3}{4}$ to its decimal equivalent, only 59 pupils (16.3%) were able to answer the question correctly. Most of the pupils used long division to solve the item since no option is given. Item 13 was the most difficult item for the pupils in symbolic representations with only 44 correct responses that is about 12% of the pupils. This indicates that pupils have difficulty in relating fractions, decimals and percentage into their various forms of representations.

Table 4 implied that there is a significant difference between the performance of pupils in graphical and contextual representations in favour of contextual representation even though the mean score of 1.9520 is low. The mean score of graphical representations of 1.1843 is also very low. The findings obtained in Table 5 indicated that there is significant difference between the performances of pupils in graphical and symbolic representations. The mean performances are respectively 1.1843 and 0.8782.

Table 6 indicated that there is a significant difference between the performance of pupils in contextual and symbolic representations at 0.05 level of significant. This means that the performance of pupils in contextual representations differ from that of symbolic representations.

Conclusion

The result showed that the pupils seemed to encounter difficulty in almost all the items in the number sense test. Pupils were not able to change a fraction to a decimal and or percentage, which is the essence in multiple representations of numbers. One can conclude that these pupils faced great difficulty in representing numbers into different representations.

Recommendations

Based on the findings the following recommendations are made:

- **(i)** There is need for teachers to help the pupils to understand the relationship between symbols and the represented concepts as well as know the rules to correctly manipulate the symbols.
- **(ii)** There is need for teachers to teach towards deep conceptual understanding which could help pupils to move among different representations of numbers.
- **(iii)** Teachers could help pupils develop number sense by using multiple solution strategies in their classroom instructions in mathematics lessons.

References

Akkaya, R.(2015). An Investigation into the Number Sense Performance of Secondary School Students in Turkey. *Journal of Education and Training Studies*,4(2). 113 -123

Retrieved December 3, 2015 from http:/redfame.com/journal/index.php/jets/article/view/1145.

Beswick, K., Muir, T., and McIntosh, A. (2004). Developing an Instrument to Assess the Number Sense of Young Children. Retrieved November 20, 2013 from www.aare.edu.au/data/publications/2004/bes04625.pdf

Facum, R.D., and Nool, N.R. (2012). Assessing the Number Sense of Grade Six Pupils. International Conference on Education and Management Innovation IPEDR, Singapore. 297-301 Retrieved April 29, 2015, from: http://www.ipedr.com/30/58/ICMI202-M1008.pdf.

Ghazali, M. (2004). An Exploratory Study into Malaysian Children's Understanding of Multiple Representations Strand of Number Sense. Retrieved October31,2010 from http://www.nku.edu/~~sheffield/ghazalipbyd.html.

Howden, H.(1989). Teaching Number Sense. *Arithmetic Teacher,* 36 (6):6 – 11.

Lassa, P.N and Palling, D. (1983). *Teaching Mathematics in Nigerian Primary Schools*. Ibadan. University press ltd.

McIntosh,A. ,Reys,B.J. and Reys,R.E.(1992). A proposed Frame Work for Examining Basic Number Sense. *For the Learning of Mathematics* 12 (3). 2- 8. Retrieved March 24, 2010 from http://www.jstor.org/stable/40248053.

McIntosh,A. ,Reys,B.J.,Reys,R.E.,Bana, J.,and Farrell, B.(1997). Number Sense in School Mathematics: Student Performance in Four Countries. Perth:MASTE.

Menon, R. (2004). Elementary School Children's Number Sense. *International journal for Mathematics Teaching and Learning*.57, 1- 16. Retrieved December 3, 2010 from http://www.exete.ac.uk/cimt/ijmenu.htm.

Naukushu, S.T. (2011). *Factors Affecting the Development of Number Sense and its Influence on Grade 12 Learners' Performance in Mathematics in the Oshana Education Region*. Master's thesis, University of Namibia. Retrieved from http:/www.isis.unam.na/thesis/naukushu2011.pdf.

Purnomo, Y.W., Kowiyah, Alyani, F. and Assiti, S.S, (2014). Assessing Number Sense performance of Indonesian Elementary School Students. *International Education Studies*, 7(8). 74 – 84. Retrieved November 8, 2015 from http://www.ccsenet.org/journal/index.php/ies/article/viewFile/36659/21665.

Sengul,S. And Gulbagci, H. (2012). Evaluation of Number Sense on the Subject of Decimal Numbers on the Secondary Stage Students in Turkey. *International online Jounal Educational Science.* 4(2), 296-310 Retrieved November 8, 2014 from http://doaj.org/article/50e40364ab9a45e98c341a6bo99f57al.

Singh, P. (2009). An Assessment of Number Sense Among Secondary School Students. Retrieved January 8, 2010 from http://www.findarticles.com/p/articles/mi-a,a3667/is-199902/ain8839302.