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Number Sense Levels of In-Service Primary School Teachers in Chikankata District, Zambia

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Abstract

This study sought to assess number sense comprehension levels of In-service Primary School Teachers (IPST). This was a mixed method study where quantitative data was collected through a number sense assessment questionnaire. Out of 82 questionnaires, 69 were successfully completed and returned representing a return rate of 84%. Qualitative data was provided by six purposively selected teachers who were interviewed using questions based on number sense. The data from the questionnaire was analyzed using Statistical Package for Social Sciences (SPSS) to come up with tables and charts. One way ANOVA was used to determine if a significant difference in performance according to teaching experience period existed. In order to identify the strategies, each response from the interviewees whether correct or wrong was coded as either number sensible or rule based. The theory of problem solving proficiency guided the study. The overall results showed the number sense levels for IPST was with most of them scoring below the basic level when tested on number sense and no significant difference was observed on performance. Further, very few number sense based strategies were utilised but IPST were confident in answering questions that involved application of a rule. This study showed to what extent IPSTs possessed the knowledge and skills that they were supposed to use for proficient teaching of numeracy. Based on the findings of this study, teacher preparatory institutions at primary school level should consider training teachers in ways that involve developing their number sense and that of learners.

Keywords: *Number Sense, In-service teachers, Numeracy, Primary schools, Estimation*

1. Introduction

The government of the Republic of Zambia has been committed to developing literacy and numeracy skills in learners through investing more in primary education as compared to secondary and tertiary education (MOE, 2000). However, one major challenge that the education system faces is the quality of education as evidenced by low performance results in the National Assessment Surveys. In 2012, 2016 for instance, learning achievement levels were low across all subjects with the poorest performance being in mathematics and science at both primary and secondary school level (Ministry of Education, 2012; 2016). According to Examinations Council of Zambia (ECZ) (2017) out of 305563 candidates who sat for the examination at junior secondary School level, 672 (0.22%) got zero in paper 1 and 24139 (7.9%) got zero in paper 2.

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These poor learning achievement results suggest that pupils are not thinking mathematically and that they probably lack number sense. According to Reys (1994) number sense is having an intuitive feeling for numbers and their various uses and interpretations, an appreciation for various levels of accuracy when computing, the ability to detect arithmetic errors and common sense approach to using numbers.

Teacher knowledge of or awareness of number sense is key to delivering quality numeracy programs and has implications for the quality of learning that students achieve (Doriney, 2016).Therefore, teachers should be confident in their knowledge and understanding of how the number system works, use this understanding in flexible ways to make mathematical judgments and have various strategies for handling numbers and operations (National Council of Teachers of Mathematics, 1991).

Research conducted in the past on number sense of pre-service teachers has shown that teachers do not possess adequate knowledge in the domain of numbers (Doriney, 2016; Akkaya, 2015; Yaman, 2015; Courtney-Clark and Wessels, 2014; Sengul 2013; Hinton, 2011; Yang *et al.,* 2007). The number sense of pre-service teachers was found to be low and most cases, the pre-service teachers were bound to using rule-based solution strategies.

For instance, Naukushu (2016) found low number sense in pre-service teachers before undergoing training. Naukushu (2016) noted that "it would be interesting to carry out a study to investigate the levels of number sense comprehension of practicing teachers". This study assessed the number sense levels of in-service primary school teachers in Chikankata District of Zambia.

2. Theoretical Framework

The study was guided by Schoenfeld (1985) theory of problem solving proficiency. Schoenfeld argued that in order to understand the success or failure of a problem solving attempt, one needs to know about the individual's; knowledge base, problem solving strategies, metacognitive actions as well as their beliefs and practices (Schoenfeld and Kilpatrick, 2008). According to Schoenfeld (1985) "if one is interested in someone's mathematical proficiency, that is, what someone knows, can do and is disposed to do mathematically, then it is essential to consider all the four aspects of mathematical proficiency. Thus for an individual to demonstrate number sense they should show general understanding of numbers, the operations and relationships between them. Number sense ability requires execution of mental calculations without using any standard algorithm (NCTM, 1991). Thus, knowledge plays a central role, as a must but an individual's ability to employ number sense strategies, the individual's ability to make good use of what he or she knows, and his or her beliefs and dispositions are also important". A strong conception of number and the quantity it represents is a critical part of all areas of daily life (Berch, 2005).

3. Statement of the Problem

Number sense can be promoted by ensuring that students learn to calculate in various ways including written, mental, approximate, and electronic methods. Sowder (1992) suggested that as teachers deal with the topic of number sense, they need to understand what characterizes number sense and need to prepare activities that present students with opportunities to explore within that framework. Reys (1994) pointed out that teaching for the development of number sense requires conscious, coordinated effort to build connections and meaning on the part of the teacher.

Mathematical difficulties are widespread in Zambia. Performance of pupils in mathematics has remained unsatisfactory (ECZ, 2017; MOE, 2013). These poor learning achievement results suggest that learners lack number sense which is a foundation on which numeracy is built and developed. Teacher knowledge of number sense is key to delivering quality numeracy programs and has implications for the quality of learning they achieve (Doriney, 2016).

Research has shown that learner performance is linked to teacher subject matter knowledge and that the lack of a sound foundation in the domain of numbers by teachers may be the root cause of low standards of learner performance in mathematics (Courtney-Clark and Wessels, 2014). It is not known, however, whether Zambian primary school in-service teachers possess number sense which is required for proficient teaching of numeracy.

The study therefore sought to establish how proficient primary school teachers were in performing number sense activities

4. Methodology

The study was carried out in Chikankata District of Zambia. An explanatory sequential design was adopted in which both quantitative and qualitative data regarding the number sense competence levels of in-service primary school teacher's was collected. "The rationale behind the approach is that quantitative data provides a general picture of the research problem; more analysis, specifically through collecting qualitative data is needed to refine, extend or explain the general picture"(Creswell, 2012). In this design, weight was given to the quantitative data and mixing of data occurred when the initial quantitative results informed the secondary qualitative data collection (Creswell and Creswell, 2017). Researchers on number sense such as Yang *et al.* (2008) and McIntosh *et al*. (1992) argued that in assessing number sense, measurement should involve both qualitative and quantitative data. In this study, quantitative data provided the general picture of the level of number sense possessed by in-service primary school teachers while qualitative data helped explain the performance in the quantitative data.

Data was collected in two phases, the first phase involved collecting quantitative data on number sense proficiency levels. An assessment test written as number sense questionnaire in free response mode adapted from Doriney (2016) was used, where 82 teachers were sampled at $\alpha = 0.05$. Out of 82 questionnaires distributed, 69 questionnaires were successfully completed and returned representing a return rate of 84%. The second phase involved collecting qualitative data to explore the strategies in-service primary school teachers used to solve number sense activities. Six (6) teachers were purposively selected and only teachers who had initially participated in answering the number sense questionnaire were considered for the interviews. Two teachers belonging to one of the categories; proficient, basic and below basic were selected depending on their scores on the number sense test.

The data was analysed using both quantitative and qualitative methods. The data from the questionnaire was analysed using Statistical Package for Social Sciences (SPSS) to come up with tables and charts. To determine the proficiency levels of in-service primary school teachers, their performance on the number sense assessment was grouped according to the four levels of number sense as proposed by McIntosh *et al.* (1992), Reys and McIntosh (2002) and refined by Markovits and Sowder (2004).One way ANOVA was used to determine if there were a significant differences on number sense performance according to teaching experience period. Qualitative data; to identify the strategies in-service primary school teachers used to solve number sense activities from the interviews, each response whether correct or wrong was coded according to one of the following categories: Number sensible, Rule based, Control and Confidence.

5. Findings and Discussion

5.1. Demographic Characteristics of Respondents

Out of 82 questionnaires that were distributed, 69 questionnaires were successfully completed and returned representing a return rate of 84%. Out of 69 respondents, 37 respondents were male while 32 were female.

5.2. Qualifications and Teaching Experience of the Respondents

The qualifications of the teachers were as follows: 30 respondents representing 43.5% had primary teachers' certificates and 37 teachers representing 53.6% had primary teachers' diploma and 2 (2.9%) teachers were University degree holders.

5.3. Teaching Experience of the Respondents

Table 1 shows the distribution of in-service primary school teachers according to teaching experience period.

Table 1: Teaching Experience of Respondents

Years	Frequency	Percentage
1-5	29	42
6-10	22	32
11 years and above	18	26
Total	**69**	**100**

As seen from Table 1, 29 teachers (42%) had a working experience of between 1-5 years while 22 teachers (32%) had 6-10 years of work experience and 18 teachers (26%) had working experience of 11 years and above.

5.4. Number Sense Proficiency of In-service Primary School Teachers

This section presents findings on in-service primary school teacher's proficiency levels in performing number sense activities.

The performance of teachers on the number sense assessment was as shown in Table 2.

Table 2: Descriptive Statistics on the Number Sense Assessment

Descriptive Statistics on the Number Sense Assessment

N=69	Mode	Minimum	Maximum	Mean	Std. Deviation
	37	8	73	36.64	17.356

As seen from Table 2, the mean performance was 36.64% and the standard deviation was 17.356 with a maximum and minimum mark of 8% and 73% respectively. These results suggest that in-service primary school teachers were not proficient in performing number sense activities. To further establish the proficiency levels of in-service primary school teachers in performing number sense activities, their performance on the number sense assessment was grouped according to one of the following categories as proposed by McIntosh *et al.* (1992), Reys and McIntosh (2002) and refined by Markovits and Sowder (2004) as follows:

- Advanced (75% and above)
- Proficient (60-74%)
- Basic (50-59%)
- Below basic (0-49%)

Figure 1 shows the distributions of primary school teachers in each of the four levels of number sense according to their performance on the number sense assessment.

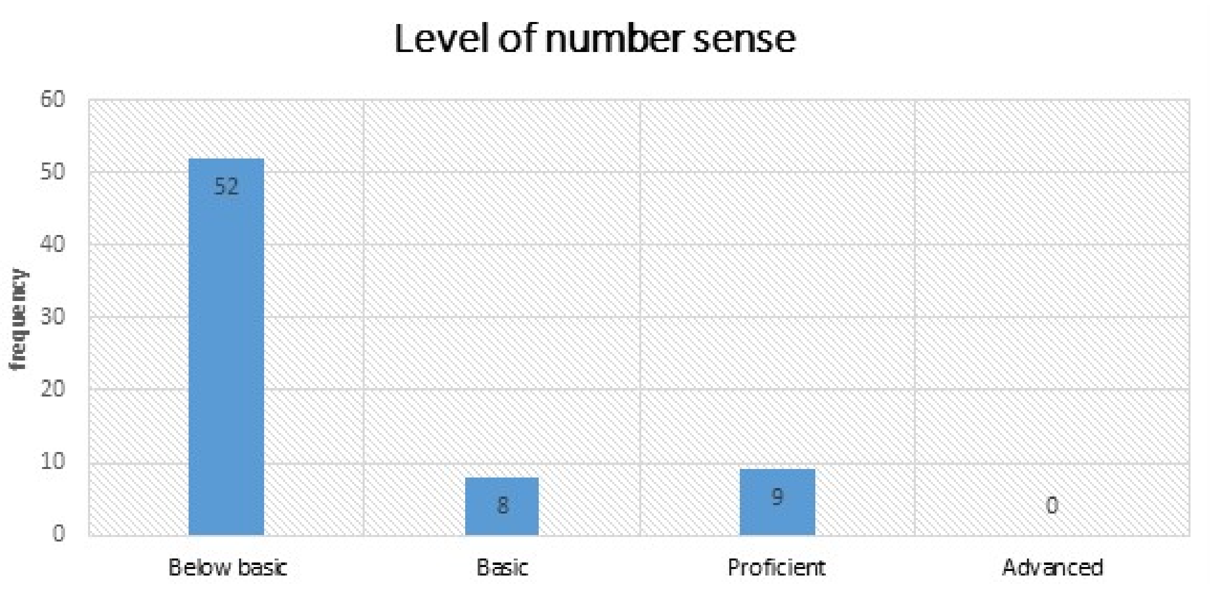


Figure 1: Distribution of Teachers According to the Four Levels of Number Sense

Figure 1 shows that 52 (75.4%) participants scored below the basic level, while 8 (11.6%) participants had number sense scores within the basic level. Only 9 participants representing (13%) had scores within the proficiency level and no participant scored a mark within the advanced level. This shows that majority of the in-service primary school teachers had low number sense with most of them scoring below the basic level when tested on number sense activities. This is in-line with the findings of Courtney-Clark and Wessels (2014) who found that pre-service teachers demonstrated limited number sense and possessed very few of the indicators of number sense. That practicing teachers had limited number sense themselves in this study was worrying because the levels of content knowledge teachers have has implications for all students and the quality of learning they achieve (Doriney, 2016).

5.5. Difference in Primary School In-service Teacher's Performance on Number Sense Activities Based on Teaching Experience

This section presents results on whether a significant difference in performance existed among in-service primary school teachers performance based on their teaching experience period. Table 3 shows the mean performance and standard deviation for each of the three groups.

According to Table 3, teachers with 11 years and above experience had the highest mean performance of 40.28% while teachers with 1-5 years of experience had the lowest mean performance of 34.17%. This was not enough to draw conclusions thus, to determine if a significant difference in performance on number sense activities according to teaching experience period existed among primary school teachers, a one-way ANOVA test was computed and Table 4 illustrates the test results.

Table 3: Number Sense Marks According to Teaching Experience Period

Years of Experience	Mean	*N*	Std. Deviation
1-5	34.17	29	15.748
6-10	36.91	22	16.767
11 Years and above	40.28	18	20.608
Total	**36.64**	**69**	**17.356**

Table 4: ANOVA Test Results

ANOVA					
Number Sense Marks					
	Sum of Squares	**df**	**Mean Square**	***F***	**Sig.**
Between Groups	416.375	2	208.187	0.685	0.508
Within Groups	20067.567	66	304.054		
Total	**20483.942**	**68**			

No significant difference was observed on in-service primary school teacher's performance on number sense activities based on teaching experience period ($F(2, 66) = 3.14$, $p = 0.508$).

This is in-line with the findings of Zubeyde and Artut (2016) who observed no significant differences in elementary school teacher's sense of number test. This results show that experience in teaching did not influence performance on number sense activities and even experienced in-service teachers found challenges in solving number sense activities. The lack of conceptual knowledge and weak number sense of teachers does not happen in a vacuum, many pre-service teachers enter teacher education programs with pre-conceived notions they formed as primary school students about the teaching and learning of mathematics (Knoell *et al.*, 2015).

In order to explore the kind of strategies teachers used to answer number sense activities, interviews were conducted. The next section presents the findings from the interviews.

5.6. Strategies Used by Primary School Teachers to Solve Number Sense Activities

Teachers were interviewed using 7 number sense items based on the framework described by McIntosh *et al.* (1992). In order to identify the strategies teachers used to solve number sense activities from the interviews, each response whether correct or wrong was coded according to one of the following categories:

1. Number Sensible: These strategies utilised aspects such as estimation, using benchmarks etc as described by the framework on number sense.
2. Rule Based: These strategies utilized standard rules of standard written algorithms.

3. Control: This category was introduced to explain the way the participants monitored and regulated themselves during the solution process such as abandoning strategies that would not lead to a correct answer and choosing new solution paths so that they could get a correct solution.
4. Confidence category was used to identify the teacher's beliefs and practices in their own ability to solve mathematical problems.

The first part presents the overall performance of teachers followed by a discussion of the performance of teachers in the three number sense domains on each item that teachers were interviewed on.

5.7. Performance of Teachers Interview Items

The overall performance of teachers on all the number sense items they were interviewed on was as shown in Table 5.

Table 5: Summary of Findings on Strategies

Item Number	Method		Responses	
	Number Sensible	Rule Based	Correct	Incorrect
1	2 Respondents -Residue strategy -Converting to decimals	-None	1	5
3	3 Respondents -Estimation	-None	3	3
4	-None	6 Respondents -Counting the number of decimal places in the two multiplicands	0	6
5	1 Respondent -Estimation	-None	1	5
6	1 Respondent -Decomposing numbers	6 Respondents -Dividing 15 into 170	5	1
Total	**7/30**	**12/30**	**10/30**	**20/30**
		Knowing		
2	-Knowledge of multiple representation of numbers		1	5
7	Knowledge of fractions		1	5
	Total		**2/12**	**10/12**

According to Table 5 very few number sense strategies were utilized by in-service primary school teachers. Only 7 out 30 possible strategies representing 23% were utilised. For instance, in attempting interview item1 only one respondent was able to use a number sensible strategy (residual strategy).

Further, only 12 out of 42 responses were correct representing 29%. Most of the correct responses were given on questions that involved application of a rule through rule based strategies. The overall performance was that 30 out of 42 responses representing 71 % were incorrect meaning majority of the answers given were incorrect. The in-service primary school teachers in this study just like the pre-service teachers described by Sengul (2013) preferred using rule-based methods instead of number sensible strategies and used similar solution strategies to those used by students in the past. They lacked strategic competence which enables one to formulate and represent problems mathematically and devise useful strategies for solving them. They failed to use concepts and procedures appropriately and could not monitor and regulate themselves by reflecting on their solutions when solving number sense activities. What one does with the facts at his or her disposal is the major determinant of the success or failure of a problem solving attempt (Schoenfield, 1985).

5.8. Performance of Teachers in the Three Number Sense Domains

The performance of teachers in the three number sense domains is presented and discussed together with corresponding items from the numbers sense assessment questionnaire since the major reason for conducting the interviews was to help explain the quantitative results.

5.9. Primary School In-service Teacher's Knowledge of and Facility with Numbers

From the number sense questionnaire, question number 17 required teachers to put two numbers 4,6,12 in the boxes □/□ to make a fraction as close as possible to 1/2. Only 24/69 responses were correct representing 35%. The performance was supported by the results during the interviews, Item1 from the interviews required teachers to recognise the relative size of numbers by stating whether 3/8 or 7/13 is closest to half. All respondents gave a wrong initial response as they all chose 3/8 as the fraction that was closest to 1/2. Only one respondent gave a correct response after probing that 7/13 is closer to 1/2. Their responses can be illustrated by the following examples:

P5: *Because or just by looking, if we say 2 into 8 it goes in 4 times but in 13 it goes 6 times and it leaves a remainder.*

P6: *Because the denominator is 8, it's when you divide by 2 it will not give you a remainder and the numerator when you divide it unlike this one when you divide it by 2 it will give you a remainder.*

P4: *Okay simply because, for such fractions you have firstly to change the fraction or in short you look for the lowest common multiple of the fractions which is 3, the lowest common multiple of 8 and 13 and 8 is closest*

The pre-service teachers had challenges establishing the relative magnitude of two fractions using as a referent point. This tallied with Courtney-Clark and Wessels (2014) findings who also found that teachers had difficulties relating magnitude of fractions using ½ as a referent point.

When tested on sense of orderliness of numbers. The fractions, 1/2, 3/5, 3/10, 3/8, 3/6 were supposed to be ordered from the least to greatest. Only 4 correct responses were given representing 6% on the number sense questionnaire. In-service primary school teachers could not recognize that 3/6 is equivalent to 1/2 in ordering the fractions. This is similar to the findings of a study by Mohamed and Johnny (2009) who observed that despite a high level of competency in performing algorithms in the classroom, students were generally weak in understanding the relative size of numbers, composing numbers and recognising the effect of operations on numbers. Mohamed and Johnny (2009) noted that "failure to master the concept of fractions and decimals leads to difficulties in understanding the concepts of percentages as well as multiplication and division of fractions and decimals".

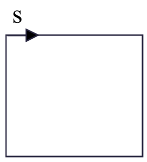
The study established that in-service teachers who took part in the interviews had limited knowledge on decimals. When asked how many decimals were there between 8.3 and 8.4, only one respondent (P3) out of 6 respondents had knowledge that there were decimal numbers between 8.3 and 8.4 and were able to give examples. Other respondents were confident just as the 6th grade students in Yang (2005)'s study that there were no decimal numbers between the two numbers. "When students were faced with non-routine questions or problems they had not come across in mathematics class, they usually lacked confidence and felt uncomfortable (Yang, 2005)". This study has shown that even practicing teachers lacked confidence and equally faced challenges on decimal numbers .That in-service teachers who took part in the interviews had limited knowledge on decimals disagrees with Reys and Yang (1998) who observed that high level performing students either in the sixth or eighth grade had no difficulties explaining that there were infinitely many decimal numbers between 1.42 and 1.43 and were able to support their responses with at least one example.

When tested on multiple representations of numbers, teachers showed limited knowledge on this number sense component. From the interviews, item 3 required teachers to identify the letter that represents a fraction were the numerator is slightly higher than the denominator, respondents found this question challenging and guessing was observable in their answers in the way they kept changing their choices and this can be summarised by P1's response below:

P1: *its D……pause….. Laughs and says these numbers…. No I think its G*

This explains why in-service primary school teachers performed poorly on the number sense questionnaire on question 16 where teachers were required to mark with an X where they would be after of the journey. The specific question was:

You are going to walk once around a square-shaped field. You start at the corner marked S and move in the direction shown by the arrow. Mark with an X where you will be after 1/3 of your walk.



Only 13 correct responses representing 13% were given by in-service primary school teachers and this showed poorly developed sense of multiple representation of numbers. This contradicts Yaman (2015) who found that some teacher candidates could answer questions involving multiple representation using number sense approaches before undergoing mathematics courses. However, this is in agreement with the findings by Reys *et al.* (1999) who found that students had challenges with this question and noted that most of the incorrect responses were due to the misconception of using the vertices as third markers by thinking of standing at one corner of the square and by so doing, what was seen was three corners which were viewed incorrectly as representing a third of a square.

5.10. Primary School In-service Teacher's Knowledge of and Facility with Operations

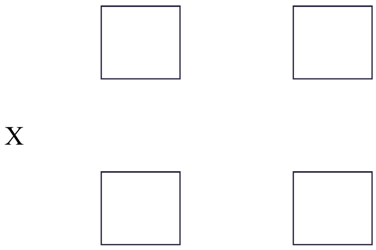
Item three from the interviews tested primary school teacher's knowledge in the number sense component of understanding the relationship between operations. Teachers were required to choose an expression which would produce a larger amount in the two expressions below.

2452 x 4

2541 + 2457 + 2460 + 2465

Three responses were correct out of six. In-service teachers showed lack of confidence in answering this question as P6 even requested to use a calculator to solve this question.

Question 12 on the number sense questionnaire tested in-service primary school teacher's understanding on effects of operation. Teachers were required to place the four digits 3, 5, 7, and 9 into the boxes below in the positions that would give the greatest result when the two numbers were multiplied.



Only 15 responses out of 69 responses were correct representing 22%. The performance did not change on this component in the interviews where teachers were required to place the decimal in the answer to the following 534.6 x 0.545 = 291 357. Only one correct response was given out of six as most of the teachers applied the rule of counting the number of decimal places which would not work unless they recognised that there should have been a zero at the end in the solution. The finding was in line with (Doriney, 2016; Courtney-Clark and Wessels, 2014). Doriney (2016) found that pre-service teachers made conceptual errors in placing the digits 3,5,7 and 9, they could not choose 93x75 as the correct answer to this problem. The most common response in this study was 97 x 53. This showed lack of conceptual understanding of operations on numbers. Such limitations in knowledge needed to be addressed before teachers could become effective teachers as "this demonstrated limited mathematical knowledge that many researchers such as Hill (2008), Ball (2008), and Shulman (1986) deemed necessary for effective teaching" as cited by Doriney (2016). In placing the decimal comma to 534.6 x 0.545 = 291 357 primary school in-service teachers just like pre-service teachers in Courtney-Clark and Wessels (2014)'s study could not utilise number sensible approaches such as noticing through estimation that for example 550 ×0.5 was more than 250 but less than 300 and therefore 534.6 x 0.545 = 291. 357.

5.11. Primary School In-service Teacher's Ability to Apply Knowledge of and Facility with Numbers and Operations to Computational Settings

Item 5 from the interviews required teachers to recognise operation and select an efficient strategy (Using benchmarks). The specific question was*:* 60 x 40 is an estimate of 63 x 37. Is the exact answer less than or equal to or more than 2400. Why, please explain your answer. Respondents found this question challenging and only one correct response was given, the rest responded that the answers will be same.

These in-service teachers exhibited poor knowledge of the relative effect of operations on numbers and did not understand that the result of multiplying two numbers depended on both numbers being multiplied. Participants lacked confidence in working out this problem involving estimation as some admitted that it was a tricky question and that they needed a pen and a paper or a calculator to solve it. This was in-line with the argument that finding the solution to questions involving estimation was quite difficult without well-developed number sense (Markovits and Sowder, 1994). Estimation was viewed as a significant manifestation of number sense and that most children and adults lacked the basic skills of estimation because of limited exposure to estimation in schools (Courtney-Clark and Wessels, 2012).

In-service teachers were confident in answering questions that involved application of rule. For example, in attempting the question:

A minibus can transport 15 people. How many minibuses would you need to transport 170 people?

In-service primary School teachers performed well on this item, only one incorrect response was given out of six. Teachers were confident with the rule based strategy of dividing 15 into 170. Performance did not change either on the number sense questionnaire on similar items. This finding contradicts the finding by Courtney-Clark and Wessels (2014) that final year pre-service teachers had challenges applying the rule based strategy correctly but supports the finding that very few note worth number sensible strategies were used by pre-service teachers. In this study, only one respondent was able to decompose and recompose 170 to 15×10 + 20 as an efficient strategy in solving this question.

The participants in the study (in-service primary school teachers) were casual in using mathematical language during the interviews (This was a sign of lack of confidence in the knowledge/content or having fuzzy knowledge about the content). The findings can be summarized by the following statements made during the interviews.

P1: *I think G…….meaning the denominator is somehow small, if you look at this one, this is 2 and this is 3, there must be small lines that are supposed to be ten between 2 and 3.*

P3: This one is 2452, even if I am to use repeated addition, this one is ahead of this one, this one is ahead of this and this is above this one.

P4: Looking at the decimal points, the place values that we are multiplying which is 534.6× 0.545, so the first one we are multiplying has one place value.

As observed from the statements in Figure 2, teachers were casual in mathematical language use during the interviews, for instance, P1 referred to divisions on the number line as 'ten small lines' between 1 and 2 while P3 in comparing numbers used the word 'ahead' instead of greater than. P4 on the other hand called the numbers that were being multiplied as place values. This supports Kapembwa (2015) who observed that teachers believed that substituting mathematical terminologies with easier every day words for concepts would resolve the challenges posed to pupils to understand mathematical words. He, however, advised that teachers should desist from substituting mathematical terminology with easier words for the concepts. Ball (1991) acknowledged that mathematical terminologies were linked to the teacher's ability to understand mathematical concepts. Thus the in-service primary school teachers were unable to use correct mathematical language as indicated in Figure 2, they did not have in-depth knowledge of the mathematics they were supposed to teach.

6. Conclusion and Recommendations

The overall results of this study showed that in-service primary school teachers had low number sense with most of them scoring below the basic level when tested on number sense tasks. No significant difference was observed on in-service primary school teacher's performance on number sense activities based on teaching experience. Very few number sensible strategies were utilised but in-service primary school teachers were confident in answering questions that involved application of a rule through rule based strategies.

This study has highlighted to what extent in-service primary school teachers possessed the knowledge and skills that they were supposed to use during the teaching process for proficient teaching of numeracy in primary schools in Zambia. The practicing teachers had limited number sense knowledge themselves which was worrying because content knowledge of teachers has implications for learners and the quality of learning they achieve.

Based on the findings of this study the following are recommended:

- Teacher training institutions at primary school level to consider training teachers in ways that involves developing their number sense and that of learners.

- Professional development programs in schools should include 'estimation' and number sense activities in order to improve in-service teachers' content knowledge in mathematics.
- Future studies could explore in-service primary school teacher's mathematical language use.

Conflicts of Interest

We would like to declare that we did not have any conflict of interest in the study.

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