Number Sense of High School Students: An Assessment

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Abstract

Having number sense among the students of secondary schools is of vital need. Achievement and future performance in mathematics largely depends on number sense of the students. The students who perform mathematical calculations via algorithm have not learned mathematics. Also it is found that there are so many cases where gender difference is prominent. Such as the boys are exposed to the out-of-family interaction while the girls are protected from it. These types of protection may affect natural development in cognitive level. So the researcher tried to find whether there is any difference of number sense development between the male and female students of secondary level. Moreover the development of number sense may depend on the classes of the students. For this purpose a sample of 241 students of classes VII, VIII and IX are taken from different schools of Malda district comprising 120 male and 126 female students of class VII, VIII and IX. The existence of number sense is measured by the Number Sense Test as developed and standardized by McIntosh et al. (1997) and adopted by Parmjit (2008). The significant difference of number sense test scores of male and female students is tested by t-test at 1% level of significance and it is seen that there is a significant difference in the mean number sense scores of male and female students. The class-wise difference of the number sense scores of male and female students are tested and it is seen that there is a significant difference of the number sense scores of male and female students of class VIII and IX at 1% and 5% level respectively but there is no significant difference of the number sense of male and female students of class VII at 5% level. The significant difference of number sense of the students across different classes is measured by F-test at 5% level of significance and it is found that there is a significant difference of number sense across different classes.

Keywords: *Number sense, Number sense test, Algorithmic calculation, Mathematics, High school students*

Introduction: To most of the school students it is seen that they think mathematics a very difficult subject. They try hard and soul to learn this subject but they cannot. Most of the students practice mathematics via algorithmic calculation and using mathematical formulae mechanically, without trying to make a minimum sense of it. Even the teachers are sometimes giving emphasize on regular practice of mathematical problems via algorithmic computation. A student who practices mathematics via algorithm regularly can get high marks in school examinations upto a certain level, but future performance in mathematics does not only depend on acquiring high marks in school examinations. It largely depends on number sense. The students who follow mechanical approach to the mathematical symbols and rarely or not at all try to make sense of the symbols and operations of mathematics, practically they cannot recognize when to apply the algorithm and which algorithm is to apply in solving a problem. Pirie (1998) also stated the same thing. According to him, "An algorithm is not itself knowledge, it is a tool whose use is directed by mathematical knowledge and care must be taken not to confuse evidence of understanding with understanding itself". But what the number sense is. Number sense refers to a person's general understanding of numbers and operations along with the ability to use this understanding in flexible ways to mathematical judgments and to develop useful strategies for solving complex problems (Burton, 1993). Number sense may be considered as the foundation from which all other mathematical concepts and ideas arise. It can be said that number sense is student's insight with the conceptual world of numbers which includes a sense in their ability to guess the appropriateness of the answer and solving a problem in a meaningful way. So the number sense is an awareness and understanding about the numbers, their relationships, their magnitudes , relative effect of operation on numbers using the mental mathematics and estimation of numbers. The student must understand how numbers are related to each other. Understanding these relationships along with the magnitudes of numbers is very important part regarding number sense. According to McIntosh et al.(1997), the number sense depends on five strands , namely, number concepts, multiple representation, effect of operations, equivalent expression and counting & computation. Based on these five strands they prepared a Number Sense Test for measuring number sense of the students. Awang & Ismail (2003) considered the case of Malaysian students and concluded that the number sense development is independent of the gender of the students. Isiksal et al (2008) studied whether the achievement in mathematics depends on sex. According to their findings the achievement in mathematics is not dependent on sex but there are some dimensions which when included the difference in achievement appear in male and female students. Ghazali & Zanzali (1999) investigated on the students of Malaysia and find that the Malaysian students are strong in mathematical computation if once they understand the procedure without making a sense of numbers and operations. Parmjit (2008) also studied the number sense of Malaysian students class-wise and gender-wise and found that the number sense varies with class and sex. All these

investigations motivated the researcher to take this little initiative to study the number sense of the students of Malda district.

Objectives of the study: The number sense is basic requirement for the future development of mathematics of a student. But the question is whether the number sense is rooted in the biological makeup of a human being or it can be developed. Gersten et al.(1999) claims that number sense is not rooted in the biological makeup of human beings. If it is developed after birth then the question is whether it is developed equally to both male and female students in present social settings, because unfortunately male and female children are not equally treated in many cases and whether it depends upon different classes. So a thorough study is needed. This is a short step of the researcher. The objective of the study is to investigate whether there is any difference in the number sense development between male and female students and whether there is any difference of number sense across different classes.

Hypotheses:
The following null hypotheses are made

    H_{01}: There is no significant difference in the mean number sense scores of male and female students.

    H_{02}: There is no significant difference in the mean number sense scores of the students across different classes.

    H_{03}: There is no significant difference in the mean number sense scores of the male and female students of class VII.

    H_{04}: There is no significant difference in the mean number sense scores of the male and female students of class VIII.

    H_{05}: There is no significant difference in the mean number sense scores of the male and female students of class IX.

Population: All the students of class VII, VIII and IX of Malda district comprise the population of the study.

Sample: To study the number sense among the students of Malda district a sample of 246 students of class VII, VIII and IX is taken from one randomly selected boys' school and one randomly selected girls' school of Malda district The gender-wise and class-wise distribution of the sample is shown in the following table :

	VII	VIII	IX	Total
Boys	43	37	40	120
Girls	44	43	39	126
Total	87	80	79	246

Tools: The number sense scores of the students are measured by Number Sense Test as developed and standardized by McIntosh et al. (1997) and adopted by Parmjit (2008). They designed this test based on five strands on which the number sense of a student depends. These are number concepts, multiple representation, effect of operations, equivalent expression and counting & computation. It is a fifty item test. Each item is to be answered

in 30 seconds. The student will get 1 score for correct answer of each item and 0 for each wrong answer.

Data Analysis: The number sense scores of male and female students show that the mean number sense score of the students is 11.54472 with S.D. 4.893171 when male and female students are taken together (Table-1). But the mean number sense score of the male students separately is 12.64167 with S.D 5.247294 and that of the female student is 10.5 with S.D 4.27618 (Table-1).

Table-1: Showing mean and S.D of number sense scores of male and female students.

Gender	Sample size	Mean	S.D
Male only	120	12.64167	5.247294
Female only	126	10.5	4.27618
Male and female together	246	11.54472	4.893171
Male of class VII only	43	10.27907	4.165616
Female of class VII only	44	9.693182	3.401564
Male of class VIII only	37	13.28378	5.026337
Female of class VIII only	43	10.01163	4.00942
Male of class IX only	40	14.5875	5.514625
Female of class IX only	39	11.94872	5.020209

Table-2: Calculation of t value

No. of total male students (N_1)	No. of total female students (N_2)	$\Sigma(x-\bar{x})^2$	$\Sigma(y-\bar{y})^2$	t value
120	126	3304.092	2304	3.502258872

Here x and y denote the number sense scores of male and female students respectively and $\bar{x}$ and $\bar{y}$ denote their respective means. t value as calculated from the number sense scores of the male and female students is 3.502258872   (Table-2) and the degree of freedom is 244. Also the critical value of t with 244 degree of freedom at 1% level of significance is 2.59612831. Since   t = 3.502258872 > 2.59612831. So H_{01} is rejected at 1% level of significance, i.e, there is a significant difference in the mean number sense scores of male and female students at 1% level.

Table-3: Calculation of F value (ANOVA)

Source of Variance	df	Sum of squares	Mean Square	F Value
Between Groups	2	451.49222	225.746111	10.08663134
Within Groups	243	5438.515908	22.3807239	

 The means of the number sense scores of the students of classes VII, VIII and IX are respectively 9.982759, 11.525 and 13.28481. Which show that the mean number sense scores increase in higher classes than that in the lower classes? That is, there is a difference

in the mean number sense scores of different classes. To study whether this difference is statistically significant or not it is necessary to test the significance of difference of the mean number sense scores by F test (ANOVA). The evaluation of F value is shown in Table-3. The F value as calculated is 10.08663134 and the degree of freedom are 2, 243. The critical value of F in 2, 243 degree of freedom at 5% level of significance is 3.03296942. That is F = 10.08663134 > 3.03296942 (critical value). So, H_{02} is rejected at 5% level of significance. Which mean that there is a significant difference in the mean number sense scores across different classes at 5% level of significance.

Table-4: Calculation of t value of the difference of male and female students of class VII

No. of male students of VII(x)	No. of female students of VII(y)	$\Sigma(x-\bar{x})^2$	$\Sigma(y-\bar{y})^2$	t value
43	44	746.1512	509.108	0.710981

In Table-4, x and y denote the number sense scores of male and female students of class VII respectively and $\bar{x}$ and $\bar{y}$ denote their respective means. t value as calculated from the number sense scores of the male and female students of class VII is 0.710981 (Table-4) and the degree of freedom is 85. Also the critical value of t with 85 degree of freedom at 5% level of significance is 1.98826791. Since t = 0.710981<1.98826791. So H_{03} is accepted at 5% level of significance, i.e, there is no significant difference in the mean number sense scores of male and female students of class VII at 5% level.

Table-5: Calculation of t value of the difference of male and female Students of class VIII

No. of male students of VIII(x)	No. of female students of VIII(y)	$\Sigma(x-\bar{x})^2$	$\Sigma(y-\bar{y})^2$	t value
37	43	934.7703	691.2442	3.196018

In Table-5, x and y denote the number sense scores of male and female students of class VIII respectively and $\bar{x}$ and $\bar{y}$ denote their respective means. t value as calculated from the number sense scores of the male and female students of class VIII is 3.196018 (Table-5) and the degree of freedom is 78. Also the critical value of t with 78 degree of freedom at 1% level of significance is 2.64034002. Since t = 3.196018 >2.64034002. So H_{04} is rejected at 1% level of significance, i.e, there is a significant difference in the mean number sense scores of male and female students of class VIII at 1% level.

Table-6: Calculation of t value of the difference of male and female Students of class IX

No. of male students of IX(x)	No. of female students of IX(y)	$\Sigma(x-\bar{x})^2$	$\Sigma(y-\bar{y})^2$	t value
40	39	1216.444	982.8974	2.194074

In Table-6, x and y denote the number sense scores of male and female students of class IX respectively and x̄ and ȳ denote their respective means. t value as calculated from the number sense scores of the male and female students of class IX is 2.194074 (Table-6) and the degree of freedom is 77. Also the critical value of t with 77 degree of freedom at 5% level of significance is 1.99125441. Since t = 2.194074 >1.99125441. So H_{05} is rejected at 5% level of significance, i.e, there is a significant difference in the mean number sense scores of male and female students of class IX at 5% level.

Conclusion: The above results show that the mean number sense score of the female students is slightly less than that of the male students. Also by t- test it is seen that there is a significant difference of the mean number sense scores of the male and female students at 1% level of significance. Also the class-wise difference of the number sense scores of male and female students are studied and it is seen that there is a significant difference of the number sense scores of the male and female students of class VIII and IX at 1% and 5% level of significance respectively. But there is no significant difference in the number sense scores of male and female students of class VII at 5 % level of significance. The calculated value of the mean number sense scores of the students of the higher classes are seen more than those of the lower classes. Also by F - test it is seen that there is a significant difference in the mean number sense scores of the students across different classes at 5% level of significance.

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