

A STUDY OF THE STRATEGIES ADOPTED BY THE PUPILS OF ELEMENTARY GRADES FOR SOLVING BASIC ARITHMETIC OPERATIONS.

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ABSTRACT

The present investigation was a proximal study and so there was a little need to make assumptions about the parametric methods. The investigator, therefore, planned to use non – parametric methods for the purpose of analysis and interpretation of data. For identifying association between subtraction strategies adopted by the pupils of elementary grades and their achievement in subtraction and their scholastic achievement in mathematics particular, the non – parametric techniques of ‘ CHI – Square ’ was planned to be used. Also to study the degree of relationship between different attributes in numerical terms, calculation of ‘Contingency Coefficient C’ method was planned to be used in the present investigation. The results of the study showed that the sampled pupils of grades one and two were found to be using three sets of subtraction strategies namely: Modelling, Counting and Mental Strategy. It was observed that from among the 22 high achievers, 7 i.e. 32% used modelling strategy while 9 i.e. 41% used counting strategy and the rest 6 i.e. 27% used mental strategy.

INTRODUCTION

Mathematics is one of the core learning areas of the school curriculum. The Education Commission (1964-66) recommended mathematics as a compulsory subject of the study at the school level upto class X in all schools in the country.

Developing children’s abilities for mathematization is the main goal of mathematics education. The narrow aim of school mathematics is to develop ‘useful’ capabilities, particularly those relating to numeracy – numbers, number operations, measurement, decimals and percentages etc. The higher aim is to develop the child’s resources to think and reason mathematically, to pursue assumptions to logical conclusions and to handle abstraction. It includes a way of doing things and the ability and the attitude to formulate and solve problems. (NCF, 2005, Pg. – 38)

At the primary stage of education teaching and learning of mathematics as a curricular subject occupies a strategic place because during this period the foundations of mathematical thinking are laid. “Mathematical

ideas as has been rightly said are not acquired by listening to the teachers and repeating their words rather they are acquired as a result of the individual's own investigation"(Bunker A.P.,1969).

Addition and subtraction occupy a central place in Mathematics curriculum. One of the areas in which greatest degree of coherence has been achieved is the acquisition of basic whole number addition and subtraction concepts by young children.

Vernand (1982) has argued that the concept of additive structure of which simple addition and subtraction are the most elementary examples underlies a large portion of mathematics and develops over an extended period of time. This tends to happen at the expense of development of number sense and skills of estimation and approximation. The result frequently is that students, when faced with word problems, ask "Should I add or subtract?" This lack of a conceptual base continues to haunt the child in later classes. All this strongly suggests that operations should be introduced contextually. This should be followed by the development of language and symbolic notation, with the standard algorithms coming at the end rather than the beginning of the treatment.

Children of different mental level are made to learn the course content within a specified period of time. It is observed that learners of same grade display variations in the achievement of various mathematics concepts and skills. The factors responsible for varying achievement could perhaps not be identified unless an investigation is conducted into the assessment of kinds of intellectual strategies pupils adopt to solve problems in mathematics. Keeping this necessity in mind the present study was planned to identify the strategies that children adopt to solve subtraction problems.

NEED OF THE STUDY

Children abstract mathematical concepts from the environment which are meaningful to them. In the years before school, virtually, all children possess a foundation of informal knowledge on which they build a more formal and precise understanding of concepts taught in the school. In order to build a sound mathematical base it is desirable to know what mathematical knowledge children are capable of acquiring and how they use the acquired knowledge in any situation.

At primary level, the bulk of the course content in mathematics is arithmetic and central to the proficiency in arithmetic is the acquisition of number concept and operations on numbers. In primary classes, children are taught the operations – addition and subtraction on numbers in elementary grades.

Children's attitudes towards mathematics in general, may also depend to a large extent on the way addition and subtraction concepts are introduced to them at these early stages. Early experiences may be influential in determining children's attitude towards mathematics later on in life. Hence we need to understand

children's early development of number and counting competencies as a prelude to the effective teaching of addition and subtraction.

This means that it is important for teachers to find out first the level of development of their pupils, their counting skills and the strategies these pupils use in solving addition and subtraction tasks, before designing instruction to take care of their individual cognitive differences. The challenge to teachers of young children is to provide a carefully structured, activity-based curriculum keeping in view the strategies used by the students for solving problems, within a well-resourced environment, built around high teacher involvement and opportunities for children to learn together.

The children usually found subtraction more difficult than addition and in order to find out how children tackle the subtraction problems, it was important to first undertake a survey of the methods the children use to solve the problems involving subtraction.

Though a number of studies have been conducted in this area in other countries very little is reported about the work in India. Identification of subtraction strategies that children use at elementary level would help the teachers to understand how children are interpreting subtraction. This feedback would encourage teachers towards better transaction of instructions in subtraction.

The present investigator considered it important to find out what strategies children use to solve subtraction problems. Keeping in mind the aim of the study, the investigator decided to take up the following problem for investigation.

OPERATIONAL DEFINITIONS

- **Strategies :**

Alley and Deshber (1979) defines strategies as “technical principles or rules that facilitate the acquisition, manipulation, integration, storage and retrieval of information across various situations and settings.”

- **Elementary Grades :**

Since addition and subtraction is taught in grades one and two of elementary level. The elementary grade pupils sampled in this study are pupils studying in grades one and two.

OBJECTIVES OF THE STUDY

The following were the objectives of the study.

1. To identify the subtraction strategies adopted by the pupils of grades one and two.

2. To identify the pattern of subtraction strategies used by the pupils of grades one and two at different levels of achievement.
3. To find out if there exists association between subtraction strategies used by the pupils of elementary grades and their achievement in subtraction.
4. To find out if there exists association between subtraction strategies used by the pupils of elementary grades and their scholastic achievement in mathematics.

HYPOTHESIS

The following were the hypothesis for the study.

H1 – There exists association between subtraction strategies used by the pupils of elementary grades and their achievement in subtraction.

H2 – There exists association between subtraction strategies used by the pupils of elementary grades and their scholastic achievement in mathematics.

VARIABLES IN THE PRESENT STUDY

Independent Variables: Subtraction Strategies

Dependent Variables: Achievement in Subtraction and in Mathematics

DELIMITATIONS OF THE STUDY

Keeping in view the limitations of available time and resources, the present investigation had to be conducted with the following delimitations.

- In order to minimise the effects of moderator variables like the school plant, socio – economic status of children, teacher’s competence etc the study was conducted in only two schools – one private school (PRABHU DAYAL PUBLIC SCHOOL) and one government school (SARVODYA BAL KANYA VIDYALAYA) of North Delhi.
- As the study needed individual administration of tests the sample was restricted to eighty students (forty students each of grades one and two).
- The study adopted only qualitative descriptive approach and quantification was limited.

DESIGN OF THE STUDY

The present investigation was a small descriptive survey aimed at identifying the subtraction strategies used by the pupils of elementary grades.

THE SAMPLE

Since the time as well as resources available for the study were limited the sample of necessity had to be small.

Moreover, all the tests of the study were to be administered individually and the subjects were young children viz. the pupils of elementary grades, the testing was time consuming. Therefore, the investigator had to restrict the size of the sample. In view of this it was planned to select about 80 cases for the present study. In order to minimise the effects of the other intervening variables as socio economic status, environmental stimulation, school plant facilities etc, it was planned to identify one government and one private schools of the same area for the present investigation.

- PRIVATE SCHOOL - PRABHU DAYAL PUBLIC SCHOOL
- GOVERNMENT SCHOOL – SARVODAYA BAL KANYA VIDYALAYA

20 students each of grade one and two were selected using random sampling procedure from both the schools which gives us a total sample of 80 students.

TOOLS USED FOR THE STUDY

The following were the tools used in the present study :

- Subtraction Strategy identification Test (oral and written) adopted from the studies of G.M.Bolton and Lewis (1993) and Arora (1998) was used to identify the subtraction strategies adopted by the pupils of elementary grades to solve subtraction problems.
- Achievement Test in Subtraction constructed and developed by the investigator was used to find the association between subtraction strategies and achievement in subtraction.
- Scores of Scholastic Achievement in Mathematics (marks in mathematics in the annual examination) obtained from the school records were used to find association between subtraction strategies and achievement in mathematics.

STATISTICAL TECHNIQUE USED

The present investigation was a proximal study and so there was a little need to make assumptions about the parametric methods. The investigator, therefore, planned to use non – parametric methods for the purpose of analysis and interpretation of data. For identifying association between subtraction strategies adopted by the pupils of elementary grades and their achievement in subtraction and their scholastic achievement in mathematics particular, the non – parametric techniques of ‘ CHI – Square ’ was planned to be used. Also to study the degree of relationship between different attributes in numerical terms, calculation of ‘Contingency Coefficient C’ method was planned to be used in the present investigation.

CONCLUSION

The conclusions of the present study that could be drawn from the results are as follows: –

- **The Subtraction Strategies adopted by the pupils of Elementary Grades**

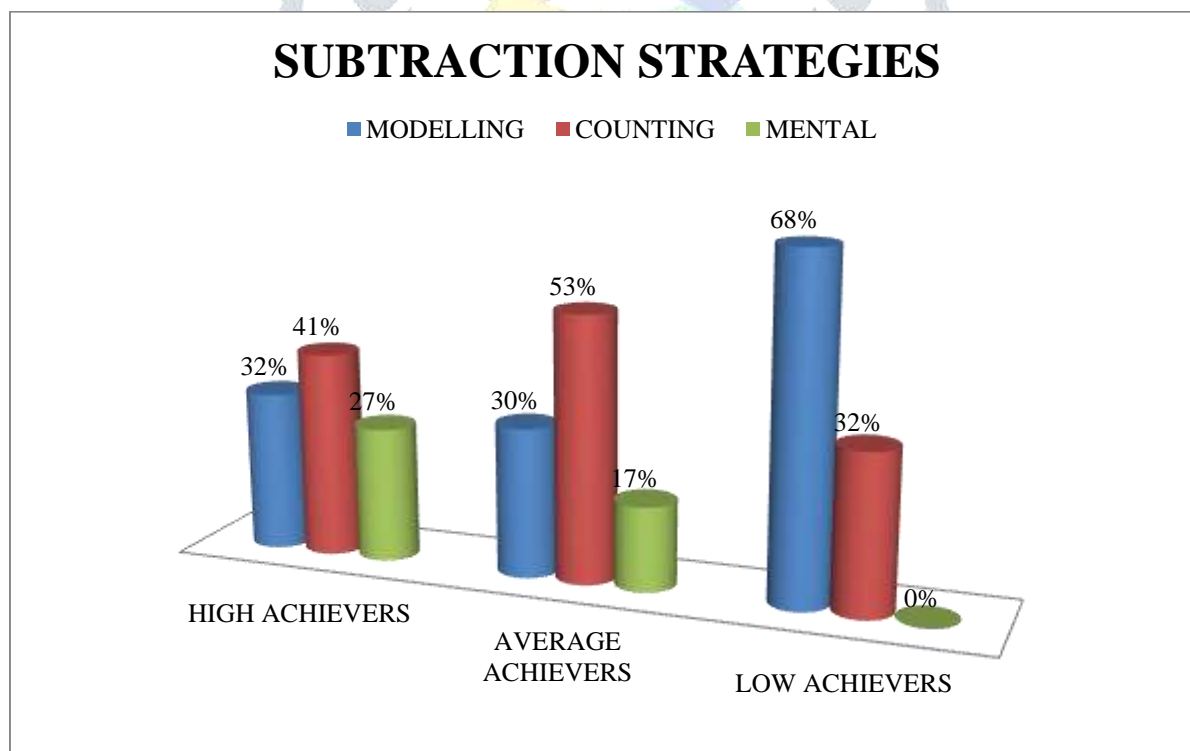
The sampled pupils of grades one and two were found to be using three sets of subtraction strategies namely : Modelling, Counting and Mental Strategy.

- **The pattern of Subtraction Strategies used by the elementary grade pupils at different levels of achievement**

From the above graph, it can be observed that from among the 22 high achievers, 7 i.e. 32% used modelling strategy while 9 i.e. 41% used counting strategy and the rest 6 i.e. 27% used mental strategy.

In case of average achievers 11 out of 36 i.e. about 30% used modelling strategy, 19 i.e. 53% used counting strategy and the rest 6 i.e. 17% used mental strategy.

As far as low achievers are concerned 15 i.e. 68% used modelling strategy and 7 i.e. 32% used counting strategy with none of the student using mental strategy.



It can be thus concluded that Counting strategies were mostly used by the bulk of average and high achievers while modelling was used by a majority of low achievers with some of them also using counting strategy. Mental strategy was only used by the high and average achievers.

- **Association between subtraction strategies used and achievement in Subtraction**

The association between subtraction strategies used and achievement in subtraction was highly significant at 0.01 level with the value of $\chi^2 = 32.37$. However, the extent of association was moderate.

<u>LEVEL OF ACHIEVEMENT</u>	<u>MODELLING STRATEGY</u>	<u>COUNTING STRATEGY</u>	<u>MENTAL STRATEGY</u>	<u>TOTAL</u>
HIGH ACHIEVER	2 (8.8)	11 (9.9)	11 (3.3)	22
AVERAGE ACHIEVER	18 (14.4)	17 (16.2)	1 (5.4)	36
LOW ACHIEVER	12 (8.8)	10 (9.9)	0 (3.3)	22
TOTAL	32	36	12	80

- **Association between subtraction strategies used and achievement in Mathematics**

Association between subtraction strategies used and achievement in Mathematics was also significant at 0.05 level with the value of $\chi^2 = 12.3$.

<u>LEVEL OF ACHIEVEMENT</u>	<u>MODELLING STRATEGY</u>	<u>COUNTING STRATEGY</u>	<u>MENTAL STRATEGY</u>	<u>TOTAL</u>
HIGH ACHIEVER	7 (9.08)	9 (9.62)	6 (3.3)	22
AVERAGE ACHIEVER	11 (14.85)	19 (15.75)	6 (5.4)	36
LOW ACHIEVER	15 (9.08)	7 (9.62)	0 (3.3)	22
TOTAL	33	35	12	80

EDUCATIONAL IMPLICATIONS

The findings of this study, though tentative on the account of limited sample, do have implication as far as teaching and learning of subtraction of numbers in early primary grades is concerned. Identification of the subtraction strategies that children use would perhaps help in understanding how children perceive the

problems of subtraction and how they solve them. Such an understanding would be of considerable help in designing meaningful instructional programmes in mathematics for the children in early stages of elementary education.

The results of the study also reveal that the pupils of the same grade use different strategies to solve subtraction problems. The children at lower grades tend to use modelling strategies while those at higher grades tend to use mental strategies. Average students tend to use counting strategies in solving subtraction problems. If teachers take note of this, instructions can be arranged likewise and the pupil may find instructions more meaningful. Also emphasis on adoption of higher order subtraction strategies i.e. mental strategies may perhaps result in qualitative improvement in learner's achievement.

SUGGESTIONS FOR FURTHER RESEARCH

Any investigation answers only a few questions and very often that in a partial manner, emphasising that further investigation will be necessary in the same area. Thus the conclusion reported in this study may be considered only as a precursor to more researches in this area. Since the data for the present study was drawn from a very limited source the correlation values may not be satisfying to the demanding researches but it does provide impetus for further investigation. The following research studies, however, are suggested which may be taken up in this area:

- Replication of this study may be undertaken in M.C.D Primary Schools in different regions of Delhi as well as the other schools like public schools and Kendriya Vidyalayas to confirm, modify or reject the findings of this study.
- The present study may be extended to grade three or five of primary stages to ascertain at which grade all children adopt mental strategies and none of them adopt elementary strategies like modelling for solving subtraction problems.
- Studies may be taken up to ascertain variations, if any, in subtraction strategies adopted by the children of rural and urban schools.

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