Chapter V

Summary, Findings, Suggestions & Educational Implications
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"Enough research will tend to support your conclusions"

- Arthur Block

5.1 Introduction:

Like interpretation of results the formulations of conclusions and generalizations also demand keen observation, wide outlook and power of logical thinking. An educational researcher has to exercise all care and caution in reporting the findings and formulating the conclusions and in arriving at any generalizations on the basis of the data.

In the previous chapter the investigator has presented the analysis, interpretation and discussion of the results in detail. This chapter deals with the summarization of the study; consolidation of the various findings; formulation of conclusions and generalizations. Finally educational implications are derived and suggestions are given to parents, teachers based on the present research.

5.2 Summary of the study:

Mathematics is taught mostly like a mechanical subject with no creativity and imagination. Students are trained to develop mathematical skills of calculation and construction. They are not encouraged to develop mathematical thinking, mathematical aptitude and problem solving approach.
Mathematical problem solving occupies a very important place in the teaching of mathematics. A mathematical problem puts a question mark in the minds of the students and it is solved by thinking in a critical, logical and if needed, in creative way. In problem solving the pupils have to take right decisions and convert the problem in to systematic and sequential steps. Afterwards the child needs to effectively communicate the process of solving the problem.

Our society has moved into a technological era. Mere acquisition of arithmetic’s skills is not sufficient. The mathematical curriculum has therefore undergone periodic changes. In the sixties there was a wave of modern mathematics throughout the world including our country. Whether the programme of modern mathematics is successful or not is not relevant. But mathematics education which is qualitative better in undoubtedly the need of the day as we need people with sound mathematical abilities.

The Education Commission (1964-66) recommended mathematics as a compulsory subject for all school students. Thus mathematics enjoys a unique status in school curriculum.

Mathematics has been described as the mirror of civilization and as the “hand maiden” of all sciences. Without an adequate comprehension of mathematics a student in pursuit of science is irrevocably stymied. The Education Commission Report (1964-66) observes: “The advent of automation and cybernetics in the country marks the beginning of new scientific industrial
revolution and makes it all the more imperative to devote attention to the study of mathematics”.

Mathematics is the main stay in today’s systematic life. Without numerical and mathematical evidence one cannot decide many issues in day to day life.

The place of mathematics in modern education must be determined by an analysis of the culture and civilization of the modern society. The Kothari Commission report (1964-66) rightly points out that study of mathematics plays a prominent part in modern education. It says, “one of the outstanding characteristics of scientific culture is quantification” mathematics therefore assumes a prominent position in modern education.

Mathematics education in schools is more emphasized as it improves concept development, foster higher cognitive abilities and skills. Mathematics is a very useful subject for most vocations and specialized courses of higher learning. At the higher secondary and university stages most of the physical and social sciences require the applications of mathematics. No other subject can be a substitute for mathematics. Thus mathematics has now become a compulsory subject in the school curriculum.

Learning mathematics is basically a constructive process which means that pupils gather, discover, create mathematical knowledge and skills mainly in the course of some social activity that has a purpose. Consequently classroom instruction of maths should move away from the information
transmission model and meaning and authentic context should play a crucial role in mathematics learning and teaching. Therefore we need an integrated approach to mathematics teaching.

We need to integrate conceptual knowledge of mathematics with its procedural knowledge. There is a big gap between understanding of mathematical concepts and the procedures through which they can be applied to various situations. Unless this gap is bridged proper mathematical knowledge cannot be developed among students. This can be done through mathematization and mathematical modeling.

The process of developing mathematical concepts, ideas through real world is called conceptual mathematization, which involves representing relationship with in complex situations in such a way as to make it possible to put them into quantitative relationship with one another.

Mathematics as explained earlier is a sequence subject and is also a complex system of concepts. The pupil should be helped to have a carefully chosen set of mathematical experiences through learning in order to help him/her to form a new concept. If the concepts at the foundation level are clear then interest and enjoyment become automatic in mathematics. The clarity of fundamental concepts and procedures also helps the learner to master difficult concepts of higher order. Many pupils find mathematics a difficult subject whatever be the reason for this attitude.
National Policy on Education (NPE 1986) also emphasises that mathematics should be visualized as the vehicle to train a child to think, reason, analyze and articulate logically, apart from being a specific subject, it should be treated as concomitant to any subject involving analysis and reasoning and yet many school students find difficulty in learning of mathematics and fail in mathematics. A major reason for the failure is that the teachers quite often pay no attention to the basic concepts. Hence the researcher felt the need to highlight and clarify the importance of concept formation in mensuration, sets and symmetry at the secondary school level.

At present education in general is mostly bookish and knowledge oriented. To remedy this situation mathematics education must be strengthened in relation to the learning of concepts because concepts are the fundamental units of thought and the building blocks of other forms of content namely formulas, principles, and theorems etc.

In recent times, most of the schools are very much bothered about getting high ranks and marks rather than meaningful and purposeful learning to have conceptual knowledge of mathematics. Therefore pupils are good at knowledge and understanding levels but they are not adopting at application and skill aspects which are essential for their success in life. In this context, the researcher felt the need to find the extent to which the pupils are able to have conceptual knowledge and basic fundamentals in mathematics on one hand and
to find the relation between conceptual learning in mathematics, spatial ability and problem solving skills.

Therefore learning of mathematical concepts by secondary school children is found very significant for the present study. The researcher intended to take up this study based on the objectives which are focused to find out the relation between learning of mathematical concepts and the extent of spatial ability and problem solving skills of secondary school pupils.

The investigator focused on some variables that could influence the learning of mathematical concepts like gender, mathematical achievement, type of concept, use of teaching aids, location and status of the school, educational background of the parents and economic status. Most of the IX class students are in the age group of 13+, this is the beginning of teenage. They are in the formal operational stage of cognitive development. In one more year they enter X class which is the most importance stage in the educational life of students as it propels them into the realm of higher education.

In the very next year they are entering into X class which is the stepping stone for their future courses of study or life. Therefore IX class pupils are the population for this research study and among them 620 pupils were selected as sample through stratified random sampling technique.

In order to collect relevant data and for testing the hypotheses framed, the researcher used three tools. Mathematical ability test that includes a variety of concepts prepared on mensuration, sets and symmetry. Difficulty level and
The discriminative power of each item was found with a tryout on 100 pupils and the 48 item test was finalized out of 60 item test after scrutinizing by the experts. Spatial ability test from differential aptitude test batteries was used and problem solving skill scale prepared by Dr. G. Venkatesan of RIE was retried to find reliability.

The investigator followed survey method for the present research work. The data was collected and analyzed to find mean, S.D, percentage of mean, $1/5^{th}$ mean, analysis of variance ($r$), multiple correlation, t-values and F-values. After analysis the following findings are drawn out.

5.3 Major findings of the study:

1. Secondary school pupils are to have an average level of learning of mathematical concepts.

2. Nearly half of the sample has average level and about two fifths has low level of learning of mathematical concepts in learning sets, mensuration and symmetry. The pupils are found heterogeneous in all the three areas of learning of mathematical concepts.

3. The secondary school pupils are found having average spatial ability. They are found heterogeneous in their spatial ability. Two fifths of the sample of pupils are found to have high spatial ability.

4. The pupils are found to have high problem solving ability and the sample is found homogeneous in problem solving skill. The noteworthy
feature of the sample is that none of them is found to have very low problem solving skill.

5. There is significant positive relationship among the learning of mathematical concepts, problem solving skills and spatial ability of secondary school pupils; between learning of mathematical concepts and spatial ability of secondary school pupils; and between the learning of mathematical concepts and problem solving skills of secondary school pupils.

6. Significant positive relationship is found between the learning of mathematical concepts and approach avoidance of the problem; between the learning of mathematical concepts and problem solving confidence and also personal control in the problem situation of secondary school pupils.

7. Significant positive relationship is found between learning of mathematical concepts and academic achievement in mathematics of secondary school pupils.

8. Boys and girls did not differ significantly in their learning of mathematical concepts.

9. Significant difference was found in the learning of the type of concept in secondary school pupils. The learning of conjunctive concepts is better than the learning of disjunctive concepts and relational concepts but
such difference is not found when the learning of disjunctive and relational concepts are compared.

10. There is significant influence of use of teaching aids on the learning of mathematical concepts of secondary school pupils.

11. Rural pupils have significantly better learning of mathematical concepts than that of urban secondary school pupils.

12. There is significant influence of the status of the school on the learning of mathematical concepts of secondary school pupils. i.e., pupils of private unaided schools are better than the pupils of private aided, local body and Govt school pupils and the pupils of Govt schools and private aided schools are better than that of local body pupils.

13. There is significant influence of the high school and college educational background of the parents on the learning of mathematical concepts of secondary school pupils; the pupils of secondary school with educated parents and college educated parents are better than the pupils of illiterate/elementary educated parents.

14. The pupils of lower middle class and upper middle class were better than the pupils of poor class. There is significant influence of the lower middle and upper middle economic background of the parents on the learning of mathematical concepts of secondary school pupils when compared with the poor but not in other comparisons.
5.4 Suggestions to teachers:

1. As the pupils are found to have only average level of learning of mathematical concept the teaching of mathematics should aim at better acquisition of basic fundamental concepts that are required in daily life.

2. A classroom mathematics teacher should not merely be satisfied with the completion of syllabus but plan for the best instructional innovative methods for clear concept formation in school pupils as it is the potential period of learning.

3. Mathematics teachers have to attend in-service training programmes to equip them well.

4. Teachers have to introduce varied mathematical shapes, encourage the pupils to observe in their daily life and visualize use of space relations in life.

5. Mathematics teachers can educate the pupils in the way of perceiving the problem, approaching it and dealing with the problem and impress on its transfer value to day to day situations.

6. The use of teaching aids by teachers adds to the clear comprehension of learners.

7. Every mathematics teacher can start mathematics club in school.
8. Every mathematics teacher must be sensitive to introspect with the following question "how best can I make my students as good problem solvers in mathematics"?

9. Mathematics teachers have to remove the wrong notions in the minds of pupils towards mathematics, such as, "mathematics is an abstract and difficult subject". This can be done by highlighting the concrete use of each topic of mathematics and also by making the pupils understand the evaluation of mathematics which clearly tells them that mathematics is a man made subject.

5.5 Suggestions to parents and curriculum framers as well as textbook writers:

1. Parents should not bother their children too much for marks and ranks and instead encourage them for meaningful learning of mathematical concepts.

2. Parents should realize that they have to understand the capability of their children's and encourage them accordingly.

3. Parents to have create and maintain healthy atmosphere at home and take care of children in studies.

4. Parents shall provide for their children better learning opportunities.
5. Curriculum framer to have included all the fundamental concepts in the curriculum.

6. Textbook writers have to never neglect to introduce mathematical concepts clearly from simple to complex, easy to difficult and known to unknown.

5.6 Suggestions to further research:

1. A study may be taken up to find out learning of concepts in other school subjects like science, social studies etc.

2. A study may be done on the inclusion of activities on learning concepts in the regular curriculum.

3. A study may be undertaken to prepare modules on learning concepts in each topic of mathematics at the secondary school stage.

4. A study may be taken up to find out the impact of learning of mathematical concepts on daily life.

5. A study may be undertaken on the remaining areas apart from sets, Mensuration and symmetry in mathematics.

6. A study may be taken up to find out the influence of problem solving skills on their success in life.

7. A study may be taken up to find out the influence of any specific teaching strategies on their learning of mathematical concepts.
8. A study may be taken up to find out relation between the learning of mathematical concepts with other school subjects.

5.7 Educational Implications:

1. This study will enable the pupils to identify the need and importance of learning of mathematical concepts.

2. This study will help to find out ability of the high school pupils in different areas of learning of mathematical concepts.

3. This study will enable the teacher to identify the need and importance of spatial ability.

4. This study will help the teachers to know about the ability of the high school children in applying the mathematical knowledge in problem solving skill.

5. This study will help the mathematics teachers to focus their attention on their teaching of mathematical concepts.

6. This study will direct the teachers to develop better teaching strategies to care the pupil's comprehension of mathematical concepts.

7. This study will catch the attention of curriculum framers and text book writers to keep their mind on the development of concepts through different subjects of education.
8. The pupils can be given the task of framing the mathematical problems analogous to the problems given in the text books.

9. Real life related approach in understanding many mathematical concepts can facilitate better learning of them.

10. Mathematics teachers can remove some of the wrong attitudes in pupils towards mathematics, develop confidence in them tapping their abstract abilities.

5.8 Conclusion:

Learning mathematics is basically a constructive process that extends beyond learning concepts, procedures and their applications. Mathematics is more than vast collection of fixed concepts and skills. Butler and Wren (1960) maintain that through the teaching of mathematics students attain higher intellectual and mathematical abilities like logical thinking, rational reasoning, attending to the essential aspects of the sum, orderly presentation, precision, accuracy, analytical and inductive skills and above all general problem solving abilities and spatial abilities.

Most of the secondary school pupils have good problem solving skill in their performance. But it is sad to find that the IX class pupils have only average level of learning of mathematical concepts. As per the results of the present study another noticeable finding is that most of the pupils have average level of spatial ability. But there is an interesting finding that shows positive
relation between learning of mathematical concepts, problem solving skills and spatial ability of secondary school pupils. The learning of mathematical concepts significantly influenced their academic achievement. Another noticeable finding is that the educational background of the parents has significant influence on their children's learning of mathematical concepts. Another appreciable finding is that girls are on par with boys in learning of mathematical concepts. The status of the school, use of teaching aids and type of concepts also have significant influence on the learning of mathematical concepts. And the most important rare finding is that rural pupils have better learning of mathematical concepts than that of urban pupils. Therefore efforts are to be made caring these directions to improve the teaching and learning of mathematical concepts in secondary schools by focusing more on concepts in mathematics rather than mere formulae and exercise and developing the problem solving skills and spatial ability and re-orienting the teachers and parents towards these aspects.