Chapter I

Theoretical Framework

CHAPTER I
THEORETICAL FRAMEWORK

1.1 Mathematics – Relevance, Objectives at Secondary School Level

Newsom (1951) "Our citizens, especially in a democracy must possess competency in making wise decisions ..... they must be able to participate in and evaluate decision; they must understand the origins to existing knowledge and the expansion of the that knowledge. If such are the goals of education, mathematics must be basic part of the curriculum on every level".

Plato translated by Lee, (1987) "..... the study of arithmetic it occurs to me what a subtle and widely used instrument it is for our purpose, if one studies it for the sake of knowledge and not for commercial ends ....., it draws the mind upwards".

NPE (1986) "Mathematics should be visualized as a vehicle to train the pupil to think, reason, analyse and articulate logically".

Throughout, all civilizations have expected mathematics to be learnt, in order to shape thinking and make decisions. Hence it would be beneficial to reflect upon how a subject, that should help the pupil to think, to reason, is being taught. Also how it is being learnt.

Mathematics is one of the greatest of all the sciences. It was the basis of the most of the natural science of ancient times and today it is fundamental to the understanding of all sciences. It enters into every walk of life. The very purpose of mathematics would differ for different individuals. If the everyday life requirements determined the contents of our mathematics syllabuses, there would surely be very little mathematics in them. Learning of mathematics is justified because it 'trains the mind'. For what purpose does it train the mind, if it indeed does? To think logically,

very few situations in life require the use of computational skill. The large majority of mathematical processes one learns to carry out do not make any real sense. What could be more illogical than to perform a great number of quite unintelligible acroliaties with symbols for the simple reason of avoiding detention? It trains children to be hypocritical. Very little connection between what is learnt in mathematics and rest of the world. Majority of children never succeed in the real meanings of mathematical concepts. They become deft technicians in the art of manipulating complicated sets of symbols. Juggling with symbols is no more abstract than jiggling with coloured balls. The inadequacy of the typical adult when confronted with a problem involving fractions, percentage, or even simple computations of whole numbers illustrates the need for mathematical competence to some extent. The level of mathematical literacy required for everyday activities is continually rising as the following factors indicate:

(i) The increasing complexity of our economic and political life and the problems they present. (ii) The increased complexity of international relations. (iii) The development of transportation and communications. (iv) The increasingly quantitative characteristics of our leisure time and recreational activities.

Effective handling of social and economic issues arising from these trends requires that everyone be able to utilize the concepts used in the quantitative mode of thinking.

The mathematics required for effective living, acquisition of important skills, information and attitudes needed for successful living must be emphasized rather than on preparation for college. The need for equipping persons in all walks of life to meet their quantitative problems have never existed before. The secondary school mathematics is typically preparing for college.

The proportion of students who enter into skilled occupations, which require special competencies in mathematics, must be earmarked. The skilled occupations must be carefully studied to determine the mathematical competencies required

courses must be provided that will meet their vocational requirements. The purpose of these courses is defeated if they must be planned also to provide the mathematics needed by the general student.

The majority of employed adults earn their livelihood in occupational pursuits for which extensive periods of mathematical education are not required. Yet all citizens must be given the preparation needed to meet the requirements of home and community activities, and the problems of consumer-ship, public affairs and leisure and recreational activities. To construct a curriculum adequate to meet the needs of each of these groups will require careful study and experimentation.

1. What competencies are to be provided.
2. What kind of experiences will provide these necessary competencies.
3. Do the experiences provide the needed competencies, and if so, to what extent?

The objectives laid down by National Curriculum Framework (2000) are given below:

The objectives of teaching mathematics at the secondary stage are, firstly, to further enhance the capacity of the students to employ mathematics in solving problems that they face in their day-to-day life. Secondly a systematic study of mathematics has to be started here and continued further. The curriculum may include the study of relevant arithmetical concepts number system, algebra, geometry, trigonometry coordinate geometry, mensuration, graphs, statistics etc. The idea of proofs should be developed with thrust on deductive reasoning. Emphasis is to be laid on under application of mathematics by way of making data based, problems patterning to actual data of population agriculture, environment, industry, physical and biological sciences, engineering, defence, etc. Also, the students should attain proficiency in presenting information available in their environment in the form of graphs and charts, with speed and accuracy. Further the students should acquire the ability to solve problems using algebraic methods heights and distances etc. The history of mathematics with special reference to India and the nature of

mathematical thinking should find on important place. The students may be encouraged to enhance their computational skill by the use of vedic mathematics.

1.1.1 Purpose of Teaching-Learning Algebra

Algebra has been described as the most important labour saving device, invented by man. Algebra provides a new and refined approach to the study of abstract mathematical relationship through the use of a new language and new symbolism. Indispensable of algebra is for understanding the quantitative aspect of our environment, by its very nature it is disassociated from life experiences. Yet, these inherent difficulties in learning algebra may largely be overcome if we are continually aware of its use and importance in the daily life of man.

What should a pupil be able to do when he has successfully completed a course in algebra? This question has never been far from our minds for it clarifies the nature and purpose of the course for the teacher. It reminds us that the pupil must be acquiring the competencies, interest and appreciations needed for citizenship and vocational purposes. Clearly the detailed aims for various classes and pupils will differ. But insofar as algebra has unique contribution for the pupil, we can describe what we will look for in such terms as the following as per Kinney and Purdy (1960):

1. ***Symbolism***

The pupil

i. Can explain the meaning of the statement, "Words are actually symbols."

ii. Can explain the statement, "Numbers are man-made symbols."

iii. Can use, recognize, read and interpret the symbols +, -, X, =, exponents, radicals and parentheses.

iv. Can use, interpret, explain literal numbers as symbols.

v. Can explain the purposes for using symbol in mathematics.

vi. Can translate problem situations into appropriate symbols.

2. *Functions*

a. Concept

The pupil

i. Understands the meaning of dependence between quantities.

ii. Can recognize and express dependencies.

iii. Knows the different ways that dependencies can be represented.

b. Formulas, equations, variation

The pupil

i. Knows the purpose for representing relations as formulas.

ii. Can formulate a formula from a set of data or observed relations.

iii. Can evaluate a formula.

iv. Can solve a formula for different variables.

v. Can select and use a formula to solve applied problems.

vi. Can use the language of formulas, equations, and variation.

vii. Can represent variations in formulas and can evaluate the formulas.

viii. Can solve linear equations for unknowns.

ix. Can interpret solutions of linear equations in terms of their graphs.

x. Can formulate and solve equations for problem situations.

c. Graphs

The pupil

i. Can interpret bar, line, and circle charts, and graphs of equations.

ii. Can locate points on Cartesian coordinate systems.

iii. Understands the connection between number pairs satisfying equations and coordinates of points in planes.

iv. Can plot a graph of a linear equation and simple second-degree equations.

v. Can write a linear equation from a straight-line graph.

3. Familiarity with and ability to use Mathematics in Literature

a. Reference Sources

The pupil

i. Knows where to locate needed facts:
(a) Tables, (b) formulas, (c) historic facts,
(d) explanations, (e) social and economic data.

ii. Knows how to use the data he secures.

b. Current Publications

The pupil

i. Has red current publications involving algebraic data and relations.

ii. Can use learning from this course in reading current literature with understanding.

c. Work in other Courses

The pupil

i. Can understand the mathematics he encounters in reading for other courses.

4. Desirable Attitudes toward Algebra

a. Interest

The pupil

i. Asks pertinent questions.

ii. Pays attention and resists distraction.

iii. Volunteers information.
iv. Reads other sources outside class.
v. Brings in material from outside.
vi. Quotes or records pertinent material from current literature.

b. Appreciation

The pupil

i. Works mathematics vocationally – puzzles, oddities, problems.
ii. Reads mathematical sources of pleasure.
iii. Can defend the importance of mathematics in history and in current life.
iv. Understands algebra as an integrated science rather than one with unrelated parts.
v. Can fit topics into the structure of algebra.

Such explicit descriptions of objectives would be useful for teachers rather than vague statements. These are the targets that teachers can use as indicators to check the deficiencies on a continuous basis. If the pupil cannot use, recognize, read, interpret the symbols +, -, X, =, exponents radicals, parentheses, this should send an alarm. The teacher should have similar list of competencies, or aims to indicate areas of deficiency rather than administering a test to find them. Teaching any concept without ensuring the basics is futile.

1.2 Teaching-Learning of Mathematics

Are the mathematical ideas explored, discussed, shared enhanced. The objectives of teaching mathematics may look to be well drawn out. The reality may be different. Teaching of mathematics has hardly anything remarkably distinct/different to achieve the objectives. All that matters is the right answer. Undue stress on memory intensive procedure rather than discussion, hampers the purpose of mathematics education.

A subject which has its influence in all fields and permeates human life, seems to be on the urge of being opt out. The reason could be, unthoughtful teaching. People are not able to use mathematics learnt at schools because it is so closely tied to peculiar unrealistic practices. The transfer is poor because school mathematics and out of school mathematics have no common ground.

This could be due to the approaches of teaching mathematics. Does the approach ask more of pupil's memory or thinking, adaptation of methods and interpretations of different situations? A different dimension to teaching of mathematics emerges from the constructivist perspective.

Various views

There seems to be a growing consensus among cognitive scientists and mathematical educators that abstract mathematical concepts are constructed by learners through reflection and conceptual activity. Individual differences in intellectual ability are increasingly seen as a result of both genetic variation and effect of differences in experiences. Backhouse, et al., (1992) "No learner can be expected to think as his or her teacher". "No two learners in a class can be expected to think in the same way as each other."

According to Vygotsky (1978) individual, conscious awareness is an internalized outcome of an activity in a social context and not necessarily an outcome of an experience of an absolute reality. This is particularly so in the case of higher order concepts such as those in mathematics and science. As mathematics is taught in our schools as a culture free, context free body of absolute truth with its formal algorithms, rigour and structure, little or no attention is paid by teachers and educators to the ways by which individuals construct and interpret their own mathematical knowledge. Piaget (1973) acknowledges that social interaction could play a part in promoting cognitive development. Various authors treated cultural practices as fruitful context for the study of culture-cognition relations. Geertz (1973) assumes an interdependence of context and cognition when he argues that human brain is thoroughly dependent on cultural resources for its very operations.

Smedalund (1977) contends that "..... people are always seen as logical (rational) given their own premises .....". Sigel (1981) observes "..... decontextualising the child's cognitive development is just as much as an error as denying the role of internal processing by the individual". Rogoff (1984) contends "..... context is an integral aspect of cognitive events, not a nuisance variable". Individuals 'construct' their knowledge through the generalized representation and symbols used in social interaction. The core commitment of a constructivist position is that knowledge is not transmitted directly from one knower to another, but it is built up by the learner.

Cobb, et al., (1995) Individual student's mathematical interpretation might give rise to conflicts and resolving of these conflicts would precipitate mathematical learning. The focus is on the individual autonomous learner as he or she participates in social interaction. Teacher is to initiate, guide and organize the renegotiation process while students reorganize their individual beliefs about their own role, other's role and the general nature of mathematical activity. Saxe and Bermudez (1992) state: An understanding of the mathematical environments that emerge in children's everyday activities requires the co-ordination of time analytic perspective. The first is a constructivist treatment of children's mathematics; children's mathematical environments cannot be understood apart from children's own cognizing activities. The second perspective derives from socio-cultural treatment of cognition ..... children's construction of mathematical goals and subgoals is interwoven with the socially organized activity in which they are participants."

Cobb, et al., (1995) call it as 'Emergent perspective'. According to Bauersfeld (1995), ".... the understanding of learning and teaching mathematics supports a model of enculturation rather than a model of transmitting knowledge. Participating in the processes of mathematical classroom is participating in a culture of using mathematics, ... Knowledge will be for nothing once user cannot identify the adequateness of a solution for use. Knowledge also, will be not of much help, if the learner is unable to flexible relate and transform the necessary elements of knowing into his/her actual situation". Scribner (1984) and Saxe (1991) Socio-

cultural theorists view mathematics as a cultural practice and treat learning either as a process of cultural enculturation or as an apprenticeship. Individual's mathematical activity is profoundly influenced by his or her participation in encompassing cultural practices, such as completing worksheets in the school, shopping in a market, selling candy on the street and packing creates in a daily.

Students have enthusiasm for schools that keeps them interested and involved at the elementary level. However, the students lose their zeal for learning by upper primary level. Some students lose their enthusiasm for all subjects for some mathematics is the major problem area.

- How can teacher's attitude promote high motivation in mathematics? Motivation tied to the belief that one can succeed. This assumption does not seem to be wide spread regarding mathematics. There seems to be a negative attitude towards mathematics. Children in their early years seem to believe that all can succeed. Gradually they develop a belief of lack of ability.

- Whether the student who has become proficient is problem solving and mechanical computation actually will use his/her skills in daily life situations depends on several factors. One is the degree to which the development of his/her abilities has been accompanied by the development of desirable attitude towards mathematics and its applications. This is the mental hygiene point of view. A student who is learning algebra is also learning to like algebra or to dislike algebra, to like school or dislike school; to work as a co-operative member of the group or to work for competition.

- The attitudes and interests that develop out of CR activity are often more important than the skills and knowledge that are commonly thought of as primary outcomes. The nature the student's attitude towards the personalities connected with the situation, and towards the

> school at a whole is determined in a large part by (a) the degree to which he/she recognizes the significance of the activity (b) the evidence of his/her progress or lack of progress toward the goal (c) the extent to which he feels that he is capable of overcoming the difficulties (d) the degree to which the motivation is intrinsic rather than extrinsic.

The importance of this aspect of the learning situation is shown in the large number of adults and upper-grade students who as a result of emotional blocks are incompetent in the field of mathematics regardless of their intellectual level. A large part of these blocks stem from the failure of the school to recognize the importance of the feeling to that is attached to any CR activity. Negative attitude to the learning can only hinder the process of integration. What is the position of children who enjoy learning the techniques without being aware of their meaning, i.e., of their connection with the rest of reality. The wielding of mathematical techniques pure and simple does not crystallize any practical experience of life beyond that of having learnt the techniques; if this experience is alien to the learner, it will not be integrated. Most of our children's mathematics learning does not have an integrating effect on their personalities. In fact where there is poor understanding for mathematical structure it is partly because of personal fulfillment has not been one of the aim of mathematical education.

Fundamental requirements for insightful mathematic learning: (i) wholeness of mathematical structure (ii) rich variety of mathematical structure which mathematical concepts can be limit by individual children (iii) teacher aware of individual differences in ways of learning. When child has effectively formed a concept from his own experiences he has really created something that was not there before and thus something is built into his personality. Mathematical structure - symbolism - mathematics - a structure of relationships, the formal being merely a way of communicating parts of the structure from one person to another. Mathematics teaching apprehension of such relationships with their symbolization and the acquisition of the ability to apply.

Accent in mathematics is more on structure than content concept formation takes for longer than had been believed. Much work, seemingly unrelated to the concept must be done before there is any clue to the direction which thinking is taking. Concepts could never be formed without extensive play with their ingredients. The slow realization of a direction along which our experience can gradually built into a meaningful whole. Picture clicks into focus and we feel we understand. This is followed by a period of practice to anchor the new concept into once experiences. The problem of learning is essentially how to find a kind of best fit between the structure of the task and structure of the person's thinking. Mathematical thinking will need the sort of investigation which catches the constructive process while it is still going on. Children developed constructive thinking long before logical thinking. Mathematical concepts usually contain a certain number of variables and it is the constancy of the relationship betweens these, while the variables themselves vary that constitutes the mathematical concept. As many variables as possible should be made so as to provide optimum experience in concept growth. The analytical way to critically sizing up a situation in a much more nature way of thinking and very seldom occurs in children before age of 12. Some believe that they lack ability and hence failure was inevitable.

How much do teachers encourage autonomous learning? Students are bound by their rigid dependence on rules and authority, therefore lack skill to creatively address new mathematical situations and perform tasks involving higher level thinking skills.

Karp (1991) in his study on how belief can influence motivation, opines, teachers with negative attitude tend to create teacher-dependent learning situations. Instructions given by them are based on rules and memorization. Teacher-driven practices such as teacher demonstrating the entire mathematical procedure without student contribution, are demonstrated by teachers with negative attitude student responses are generally ignored and the student participation discouraged. Surely over a period of time the limited, opportunities provided for the practice of persisting behaviors could lead to develop helplessness. Teachers with positive attitude on the

other hand foster independence. They focus on why an algorithm works demonstrating how certain mathematical skills are interrelated, identifying the common problems encountered. They encourage students to explore to discover mathematics relationships. Asking the students to prove their answers; this process of self-correction, reflective thinking leads to independently coping with mathematical tasks.

1.3 Backwardness in Mathematics

Education Commission (1964-66), has given two categories of backwardness :

i. mental handicap or low intelligence arising from hereditary or congenital factors or disease or injury.

ii. underachievement or inability to perform up to the level of one's intelligence, especially in persons, intellectually well endowed, frequently due to emotional conflict, lack of motivation, poor study habits, cultural and economic deprivation.

Kinney & Purdy (1960) has defined backwardness as 'pupils are considered backward if their educational attainments fall markedly below those of their age group.'

Burt (1937) has defined backwardness children as 'those who in the middle of their school career, unable to do the work of the class next below that which is normal of their age.'

These definitions along with the Commission's categories, give a very clear picture of a backward child. This study intents to identified individuals belonging to the second category given by the Commission which finds similarity with the other definitions given.

If the sum total of mathematics were to be limited to the immediate demands of the man on the street, no education in mathematics beyond the high school would be necessary for many people.

As Browning put it 'Man's reach should exceed his grasp, else what's a heaven for?"

It has been noted that children are eager for school when they first enter but their enthusiasm is inversely proportional to their length of exposure to the school system. They become unmotivated, enmeshed in a week of apathy, failure and frustration. For most students, school is a bore, classrooms are in general cold, impersonal over-crowded and generally uncomfortable. The examination results are like written condemnation of his/her in attentiveness which is interpreted as (1) a certificate of stupidity and (2) a testimony of both inadequacy of the teacher and the predestined futility of trying any longer.

All children need to succeed but what is meant by success. Success according to Holt, (1964) is overcoming an obstacle, including perhaps, the thought that we might not succeed. One has to also learn, beginning early, that one does not always succeed. Further, Holt, (1964) says, one should protect a child from a diet of unbroken failure.

Failure should be seen as honorable and constructive, rather than humiliating. The fear of failure influences the strategies children use. The strategies of most of the children have been self-centred, self-protective above all else at avoiding trouble, embarrassment, punishment, disapproval or loss of status. When they get a problems, one can hear than 'Am I going to get this right ? What will happen to me when I get it wrong ? Will the teacher got mad? Will the other kids laugh at me ? ..... Why am I so dumb ?"

There is so much of fear in schools and little is send or done about it. Like good soldiers, children control their fears, living with them, and adjust themselves to them. The scared fighter may be the best fighter, but the scared learner is always a poor learner.

For some children the strategy of weakness of incompetence, served to be a good one. For they feel that adults would not expect them to do anything, if they cannot do it, and they would not be blamed or punished for not being able to do it.

Incompetence reduces what others expect and demand of you and, what even you expect or hope for yourself.

Watching a baby, persistently experimenting to predict and control her environment shows how most of her waking time is spent in intense, purposeful activity, soaking up experience and trying to make sense out of it. Her learning gives her great satisfaction, whether anyone else notices it or not. Hardly an adult could in any three years of his/her life, learn as much as every infant learns in his/her extraordinary capacity for learning and intellectual growth, as one grows older. Adults destroy most of the intellectual and creative capacity of children by the things done to them or make them do.

In many ways, one breaks down children's convictions that things make sense, or their hope that things may prove to make sense. They come to feel that the source of confusion lies not in the material but in their own stupidity.

Holt (1964) "Still further, we cut children off from their own common sense and the world of reality by requiring them to play and show around words and symbols that have little or no meaning to them. Thus the vast majority of our students into the kind of people for whom all symbols are meaningless, who can not use symbols as a way of learning about and dealing with reality, ...".

Dienes (1970) "The mathematically fit survive by natural selection, rest get relegated to the mathematical lumber - room as second class citizens unfit for initiation into mysteries."

It is difficult to believe how a positive, and constructive result can come from a negative attitude. Rejection or dislike of an activity is the rejection or dislike of

that part of ourselves that is engaged in that activity. Several studies on attitude towards mathematics like Wangu and Thomas (1995), Singh et al (1994), Tzeng, Shwu-Rong (1987), Karen (1988) commented on attitude towards mathematics influenced mathematics achievement.

Why are these emotional blocks so much common in mathematics than in other subjects? In mathematics more than in any other field failure is objective and indebatable. Semantically, mathematics is the most perfect aspect of our languages. The results in mathematics are either right or wrong.

This characteristic explains both its strength and its weakness, for unless mathematics is handled expertly, early students experiences in it become a source of humiliation rather than of satisfaction. It then becomes an area to be avoided, and if there is continued failure, a source of emotional disturbance. How can emotional blocks be avoided? Some amount of failure must be expected – in fact if mathematics is made too easy, one may discourage students initiative, exploration, discovery and generalization.

Situation leading to emotional blocks are readily avoided if the teacher is aware of their true nature and the seriousness of their consequences. If the teacher observes the characteristics of a good learning situations emotional blocks will seldom occur. The influence of teacher's role, teacher's attitude towards mathematics, on students' mathematics achievement, was found by Greg (1998), Sjostrom (2000), Jain and Burad (1988), Sashidharan (1992), Rose (1991) and Chel (1990). Studies by Tzeng, Shwu-Rong (1987), Rastogi (1983), Aviles' (1989), Bhardwaj (1987), Kapur and Rosario (1992) found significant improvement and achievement leading to improvement in attitude towards mathematics. The rampant proliferation of backwardness in mathematics have cited world wide in studies by Sharma (1978), Sashidharan (1992), Bhirud (1975), Sarala (1990), Lee (1999), Tzeng Shwu-Rong (1987), Winter (1991), Sjostrom (2000), Sarangapani (1990).

Dienes (1970) "Children become deft technicians in the art of manipulating complicated set of symbols. Major part of home work and classwork is devoted to the improvement of skill in applying techniques." Present system of imparting mathematical information fails on understanding of the ideas. The whole system of classroom is an unsuitable vehicle for the transmission of mathematical information. The fundamental shortcomings in the present system cannot be patched by new methods of communication. Pupil may not be able to receive the information for some reason beyond his control or to his unwillingness. Prolonged lack of success leads to external, internal conflict. As children grow older, the popularity of mathematics soon wears off due to increased load on memory. When self-motivating learning situations are created information reaches the child that he can formulate it in his own language. Such learning situation must be individual or with small groups working together. Research indicates individual differences in the ways of forming not only mathematical but other abstract ideas. A classroom consists of real children, with real needs who will never ask whether something is useful as long as it is exciting. Motive of mathematics learning should be the thrill of discovery, encouraging the joys of doing rather than of having, Dienes (1970), Ridlon (1999), Bellisio (1999).

1.4 Education Scene in Goa

The primary education, from standard one to four is in Marathi medium in government aided schools, privately run schools have primary education in English medium. From standard five onwards all schools have English as medium of instruction.

The text-book followed upto standard seven are published by Directorate of Education, Government of Goa. From standard eight all schools followed NCERT text-books. There is switch over to Maharashtra board in the academic year 2003-2004. NCERT text-books were being followed since 1994. The Goa Secondary Education Board had delimited the syllabus by omitting some topics in Mathematics in standard eight, nine and ten in the NCERT text-books. The teachers are getting used to the new text-books. Some of the schools associations had made their common

omissions apart from those by the board. These school associations have common question paper for all their schools. Only trained teachers are appointed in standards fifth to twelfth. Teachers for fifth to seventh standard have to teach more than one subject. However, in eight and ninth standard they teach only one subject, generally.

The Goa Secondary School Education Board has made promotion policy separately for standards fifth, sixth, seventh and for standards eighth, ninth and tenth.

In standards fifth, sixth, seventh, all subjects carry one hundred marks weightage. In order to be promoted to the successive class, the student has to score in the following manner.

Table 1.4.1

Promotion Criteria

Number of Subjects (failing)	**Marks/ Subject (for promotion)**
One	10
Two	15
Three	20
Four	25

Hence, a student failing in four subjects out of six total subjects, will be promoted if he/she scores twenty five marks in each of the four subjects.

In standards eighth, ninth, tenth, science, maths, social studies carry one hundred and fifty marks, including practicals, while English, Marathi, Hindi, Konkani, French, carry one hundred marks.

In order to be promoted to the successive class the student has to score in the following manner. A total of thirty five marks grace is awarded.

If he/she scores thirty seven marks in science, mathematics or social studies he/she will be given fifteen marks grace to make it fifty two and declared pass.

If he/she scores twenty five in English, Hindi, Marathi, French, Konkani, he/she will be given ten marks grace to make it thirty-five and declared pass.

However, a student will not be given more than thirty five marks grace at a time.

1.5 Rationale

Holt (1964) "Of the vast body of human knowledge, there are certain bits and pieces that can be called essential, that everyone should know.".

In order to lead a life intelligently one needs some minimum essentials from the discipline of mathematics. Everyone, irrespective of age, gender, profession, performs mathematical discriminations daily in the form of 'how much', 'how many', 'how far', 'when', 'where', 'what'.

The minimum essentials required by everyone are taught in the schools. However, it has to be learnt without ambiguities, in order to use it efficiently.

Mathematics in the realm of school education, meets rough weather at the hands of teachers, students are all concerned. There is a hierarchical relationship among the concepts in mathematics. In the event of lack of basic concepts, it becomes a potential cause of difficulty in learning higher concepts as found by Sashidharan (1992), Manika (1983), Kasat (1991), Chel (1990), Shah (1985).

Repeated failure, low achievement, hardly makes one think of the plausible factor/s. Generally it is concluded as inability, lack of interest, insufficient practice on the part of the student, low SES. Rarely one would find any attempt to investigate any of these factor/s. Studies are various grades, world over have given evidences of improvement as a consequence of diagnosis and remedial programme, precisely

because the needs of the individual is looked into: Rastogi (1983), Bhardwaj (1987), Kapur and Rosario (1992).

Among the causes for learning difficulties identified by Brueckner and Bond (1955) are physiological, emotional, social, intellectual, pedagogical factors. Similar findings related to the factors leading to mathematical backwardness have been reported.

Several studies on factors leading to mathematical backwardness have identified some prominent factors; Tzeng, Shwu-Rong (1987), Kalamaros (1991), Sumangala (1995), Rajya guru (1991), Wangu and Thomas (1995), found attitude towards mathematics as a deciding factor of mathematics achievement. Influence of study habits on mathematical achievement was found by Kasat (1991). Lack of basic concepts or deficiencies, leading to mathematical backwardness was found by Sashidharan (1992), Sarangapani (1990), Sharma (1978), Winter (1991), Lee (1999), Sarala (1990). Studies by Jain and Burad (1988), Chel (1990), Rose (1991), Sashidharan (1992), Greg (1998) found that teaching methods have a significant impact on mathematical achievement. Other factors found to influence mathematical achievement were teacher's beliefs regarding the nature of mathematics. Sjostrom (2000), parental assistance in doing homework Warrick (2000), deprivation Gupta et.al. (1993), Intelligence, Verma (1996), Stella et al (1995), Jain (1979), language ability Manika (1983), Rangappa (1992), anxiety Verma (1996), Rajya guru (1991), location Srivastava (1992), Baskaran (1991).

On one hand, there is a provision for equal educational opportunity which should ensure education for all, and on the other hand one would find a great majority in the race, with loads of information with no meaning or purpose, or even no information. How such an education could offer effective, productive citizens is doubtful.

This study hence intended to look into the causes of mathematical backwardness and tryout some remedial programmes.

This study attempted to find the cause of unfavourable attitude towards mathematics, circumstances proliferating lack of basic concepts. Another major reason for doing study was to describe the situation like a report fully on what was done, why it was done and what are the implications.

The researchers who have worked on diagnosis and remediation have used quantitative methods and have stopped at developing a remedial programme. There are no reports on any case study having been done to not only identify the factors responsible for backwardness but describing the entire phenomena, how the child became backward. Rastogi (1983) developed the diagnosis tests and remedial material for eight standard, Bhardwaj (1987) had made a comprehensive diagnosis tests and remedial material for middle school. Kapur and Rosario (1992) formulated and intervention programme for grade four students. The present study attempted to describe the factors, their role in the development of backwardness, by capturing students, teachers, parents in their own terms. Emphasis was on how children feel on being backward, how they handle the situation, what would they like their teachers, parents to do for them. The study contributed a standardized achievement test for standard seven, which can be administered at the commencement of eighth standard. This would assist the teacher to know the achievement of the students, before he or she introduces any higher concepts. The diagnostic test would be useful for the students found to be backward on the achievement test. The teachers can formulate individual remedial programmes. The case studies and remedial programmes done by the investigator would open up more understanding about gaps in content knowledge, teaching methods, attitudes, curriculum, sequence of learning.

The investigator has employed both quantitative and qualitative methods in the study, depending on the data to be gathered.

Patton, (1990) "Direct quotations are a basic source of raw data in qualitative inquiry, revealing respondents" depth of emotions, the ways they have organized their world, their thoughts about what is happening, their experiences, and their basic perceptions. In order to capture the points of view of the subjects and all concerned

In the present scenario with dearth of diagnostic and remedial studies in mathematics, and in Goa, in particular, it was pertinent to persue a study of this nature.

Researchers have pointed out the severe dearth of remedial programme and lack of basic concepts leading to faulty learning of higher concepts. The study becomes more pertinent in Goa where one fails to locate any such similar study.

Studies conducted by Rastogi (1983), Bharadwaj (1987), Kapur and Rosario (1992), found diagnosis and remediation to be very effective and giving positive results. The present research scenario shows a dearth of diagnostic and remedial studies in mathematics and more so in Goa, which compelled for such a study in Goa.

The present study attempted to describe the factors, their role in the development of backwardness by capturing students, teachers, parents in their own terms. Emphasis was on how children feel on being backward, how they handle the situation, what would they like their teachers and parents to do for them. The attempt was to get to the cause through informal, test-free means. To find out what goes wrong in the day-to-day teaching process in the classroom.

The need for conducting such a study for the eighth standard was due to two reasons:

a) By seventh standard the minimum essentials in mathematics required to be considered educated, qualified to live intelligently in today's world, are introduced.

b) From eighth standard the abstract concepts of mathematics are introduced.

In the present knowledge based society, mathematical literacy has become essential. This has been emphasised by Kalamaros (1991), Winter (1991), Duncan (2000). Hence the need for a mathematically literate citizenry on one hand and

glaring mathematical deficiency on the other, is the umbrella reason for having conducted this study.

1.6 Statement of the Problem

Mathematical Backwardness and its Remediation in Goa.

1.6.1 Objectives of the Study

i. To construct and standardize an achievement test in mathematics for standard seven.

ii. To identify backward students on the basis of scores on the achievement test.

iii. To construct a diagnostic test in mathematics for standard seven.

iv. To conduct in-depth case studies to locate the causes of backwardness.

v. To formulate remedial programmes for the selected case studies.

1.6.2 Explanation of the Terms

Backwardness

In this study, students unable to score the minimum criteria, set up against the norms of the groups on the achievement test, were considered as having backwardness.

Remediation

The corrective steps taken to minimize the errors, and inculcate positive attitude towards mathematics, was considered as remediation, in the study.

1.6.3 Delimitations of the Study

The study was confined to the Ponda Taluka of Goa State. The study took into considerations only those schools following NCERT syllabus. The study looked into deficiencies in arithmetic and algebra only.