CHAPTER ONE
Introduction

1.1 The Problem
Students’ Achievement in Mathematics at the end of Elementary Education in Rural Areas of South 24 Parganas

1.2 Background of the Problem
Education is the process by which societies deliberately transmit their accumulated information, knowledge, understanding, attitudes, values, skills, competencies and behaviors across generations. It involves communications designed to bring about learning (MHRD, 2014).

The essence of modernism and progress in nations is reflected in their investment in children’s education in general. The role of education in promoting social and economic progress has long been perceived. Education enhances functional and analytical ability and thereby exposes opportunities for individuals and also groups to accomplish greater access to labor markets and livelihoods and to claim group empowerments. Education is not only a device of strengthening efficiency but is also an powerful instrument of widening and boosting democratic association and upgrading the overall quality of individual and societal life.

India has placed great priority on educating all its children, since independence. Soliciting a more just and equitable society, the Constitution of India is firm to providing to all children, opportunities for developing their potentialities and maximizing their learning in their areas of interest. But in fact, unfortunately India is not competent to reach the interminable esteemed goal of Universal Elementary Education till now.

1.3 Education in India
Education in India is provided and controlled by three levels: the central government in Delhi, the state governments and local bodies. It is directed by both the centre and the states; this has pivotal implications for designing and implementing curricula and pedagogic practices, policies for training teachers, monitoring schools, for setting standards and ensuring them, procedures for certification and ensuring overall system. The states are responsible for these functions, the centre being largely regulatory but
helping with funding. Education within these states is administered in further invasions of educational
districts, but there is little decentralization within the state. Curricular and pedagogic processes are not
locally shaped, and the state educational authority is as remote as the central government from the
viewpoint of a school. While this enables curricular homogeneity, it tends to stifle local pedagogic
ingenuity.

1.3.1. Structure of National Education System in India

India’s education system is structured by developmental stages from pre-primary to post-graduate level as
shown in Figure 1.1. Elementary education comprised of primary and upper primary is managed
separately from secondary (including higher secondary) education. Undergraduate education is typically
for three years, and 4-5 years for professional degrees. Universities are regulated centrally but managed
within the state, with a system of affiliated colleges providing undergraduate education. The Ministry of
Human Resource Development governs the overall Indian education system, with each State government
having its own Education Ministry, and a Central Advisory Board on Education providing the platform
for exchanges between the centre and states (as well as between states). For school education, the
National Council of Educational Research and Training (NCERT) is the highest body for curriculum
related issues. At the University level, every University formulates its own curricula but the University
Grants Commission regulates their functioning. There is a vibrant Open University system as well as the
National Institute of Open Schooling that strive to provide access to education cutting across potential
barriers formed by these structures.

![Levels of Education in the Indian System](image)

Figure 2.1: Levels of Education in the Indian System
1.3.2 Elementary Education

Elementary Education means the education from first class to eighth class. The Right of Children to Free and Compulsory Education (RTE) Act, 2009, became operative on 1 April 2010.

According to RTE, 2009:

1. Every child of the age six to fourteen years shall have the right to free and compulsory education in a neighbourhood school till completion of elementary education.

2. Where child above six years of age has not been admitted in any school or though admitted could not complete his or her elementary education, then he or she shall be admitted in a class appropriate to his or her age.

It provided further that a child so admitted to elementary education shall be entitled to free education till completion of elementary education even after fourteen years.

Regarding curriculum and completion of elementary education the Act stated that the curriculum and the evaluation procedure of elementary education shall be laid down by an academic authority to be specified by the appropriate Government, by notification. The academic authority while laying down the curriculum and the evaluation procedure shall take into consideration the following, namely –

(a) conformity with the values enshrined in the constitution

(b) all round development of the child

(c) building up child’s knowledge

(d) development of physical and mental abilities to the fullest extent.

(e) learning through activities, discovery and exploration in a child friendly and child centred manner

(f) medium of institution shall, as far as practicable be in child’s mother tongue

(g) making the child free of fear, trauma and anxiety and helping the child to express views freely

(h) comprehensive and continuous evaluation of child’s understanding of knowledge and his or her ability to apply the same.

Further, stated that no child shall be required to pass any Board Examination till completion of elementary education. Every child completing his elementary education shall be awarded a certificate, in such form and in such manner, as may be prescribed. The World Bank education specialist for India, Sam Carlson, has observed that RTE is the first legislation in the world that puts the responsibility of ensuring enrolment, attendance and completion on the Government. It is the parents’ responsibility to send the
children to schools in the US and other countries. The Right to Education of persons with disabilities until 18 years of age has also been made a fundamental right. A number of other provisions regarding improvement of school infrastructure, teacher – student ratio and faculty are made in the Act. The Act provides for a special organization, the National Council for the Protection of Child Rights, an autonomous body set up in 2007, to monitor the implementation of the act, together with Commissions to be setup by the states.

In practice, it generally comprises of primary (Class I–V) and upper primary (Class VI–VIII) and it forms the foundation of the education pyramid. Unless this foundation is strengthened, it will not be feasible to achieve the goal of universal access to quality education for all. According to RTE, maximum / minimum teaching hours, teaching learning equipment will be as follows as mentioned in the table 1.1.

Table 1.1: Norms and regulations for teaching – learning in RTE, 2009

<table>
<thead>
<tr>
<th>1. Teacher on basis of enrolment</th>
<th>Admitted Children</th>
<th>Upto 60</th>
<th>61-90</th>
<th>91-120</th>
<th>121-200</th>
<th>Above 150</th>
<th>Above 200</th>
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<tr>
<td>(a) Primary School:</td>
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<td></td>
<td></td>
<td></td>
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<tr>
<td>Teachers</td>
<td></td>
<td>02</td>
<td>03</td>
<td>04</td>
<td>05</td>
<td>05+ 1 Head Teacher</td>
<td>PTR ( excluding Head Teachers ) shall not exceed 40</td>
</tr>
</tbody>
</table>

(b) Upper Primary School:  
- One teacher per class, so that at least one teacher for Science and Mathematics; Social Studies; and languages  
- At least one teacher for every 35 children.  
- Where admission of children is above 100.  
- A full time Head Teacher  
- Part Time Instructors for Art Education, Health and Physical Education, Work Education.

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<tr>
<th>2. Minimum number of working days / instructional hours in an academic year</th>
<th>(i) two hundred working days for first class to fifth class</th>
<th>(ii) two hundred and twenty working days for sixth to eighth class</th>
<th>(iii) eight hundred instructional hours per academic year for first class to fifth class</th>
<th>(iv) one thousand instructional hours per academic year for sixth class to eighth class</th>
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<tr>
<td>3. Minimum number of working hours per week for the teacher</td>
<td>Forty five teaching hours including preparation hours</td>
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</table>
4. Teaching learning material
   Shall be provided to each class as required

5. Library
   There shall be a library in each school providing newspaper, magazine and books on all subjects including story books

6. Play material, games and sports equipments
   Shall be provided to each class as required

India being a vast country, there are different norms and practices among different states in elementary education dividing it into primary and upper primary stage. The researcher has tried to give some pictures of existing practices in primary and upper primary education.

**Primary stage**

- The primary stage consisted of classes I to IV in seven states/UTs whereas in twenty eight remaining states/UTs, it comprises classes I to V.

- The curriculum, syllabus and textbooks prepared by NCERT were generally adopted with certain modifications by most of the states/UTs professional body at national level, because NCERT has been developing curriculum, syllabus and textbooks, long since and also have vast experiences in this field. The other major agencies and institutions for constructing curriculum and textbooks were SIEs, SCERTs, SIERTs Textbook Boards, Boards of School Education and Boards of Primary/Secondary Education.

- The total school working days in a year were a minimum of 180 in Nagaland and Manipur and maximum to 253 in Bihar and Jharkhand. But in more than sixty per cent of the states/UTs the working days were between 201 and 220. Keeping their socio-cultural and geographical conditions in view, maximum working days were allotted by Bihar and Jharkhand had maximum number of working days in a year.

- The duration of school hours is of 2.30 hours in Assam. In eighteen states the school hours had 6.30 hours duration in a day. In a majority of states/UTs, the school hours were between 5.30 to 6.30 hours.

- The total periods per week were between 19 in Madhya Pradesh to 48 in A&N Islands, Uttarakhand, Goa, Tripura, Himachal Pradesh and Uttar Pradesh.

- The duration of a period was minimum 35 minutes in Arunachal Pradesh, Goa, Maharashtra, Nagaland and West Bengal and maximum 45 minutes in Andhra Pradesh, Bihar, Kerala, Delhi, Manipur, Pondicherry, Tripura, Jharkhand, Jammu & Kashmir, Punjab and Tamil Nadu.
• The periods allotted per week for teaching of mathematics in Class V were maximum 12 in Andhra Pradesh and minimum five in Kerala, Meghalaya, Mizoram and Nagaland. The time duration for annual examination was 2.0 hours in about half the states/UTs and maximum 3.0 hours in fifteen states/UTs. The maximum marks for annual examination were 100 in 25 states/UTs and 50 marks in nine states.

• In the curriculum evaluation, marks were given for the examination purposes in 15 States/UTs and in sixteen States/UTs, marks were given for scholastic areas and grades were awarded to co-scholastic areas. Besides, the continuous comprehensive evaluation was implemented in 23 States/UTs.

**Upper Primary Stage**

• The upper primary stage included classes VI to VIII in twenty seven states/UTs, VI & VII in Andhra Pradesh, V to VII in six states/UTs and V to VIII in West Bengal.

• The major agencies involved in curriculum construction were SIEs, SCERTs, SIERTs, Board of School Education & Board of Secondary Education. However, in seven states NCERT curriculum and syllabus was followed.

In 18 States/UTs, the working days ranged from 201 to 220. There were 240 working days in Rajasthan; overall, a minimum of 180 days were noted in Manipur and a maximum of 253 days in Bihar and Jharkhand.

• The total duration of a school hours were from 5.00 hours to 7.00 hours. In 18 States/UTs, the duration was of 6.00 hours. Double shift school timings are (7 to 12 noon) 5 hours & (10:30 to 4:30 p.m.) 6 hours.

• The total number of periods per week at upper primary stage varies from 35 in Kerala, Pondicherry, Nagaland and Mizoram; and maximum 54 in Himachal Pradesh & Haryana. In eleven states/UTs, 48 periods were allotted.

• The duration of periods was minimum 35 minutes in Daman & Diu, Goa, Himachal Pradesh, Maharashtra, Uttarakhand, Haryana, Gujarat and Dadra & Nagar Haveli; and maximum 45 minutes in Andhra Pradesh, Assam, Kerala, Tamil Nadu, Manipur, Nagaland, Pondicherry, Jammu & Kashmir, Meghalaya and Madhya Pradesh. In seventeen states/UTs, the duration of period was 40 minutes. In Rajasthan the first six periods are allotted 40 minutes and the remaining 2 periods are allotted 30 minutes. In Uttarakhand, first 4 periods are of 40 minutes and last 4 periods are of 35 minutes duration.

• The periods allotted per week for teaching of Mathematics in class VII & VIII were minimum 5 and maximum 9. The time allotted for examination was 1.0 hours to 3.0 hours and the marks allotted for annual examination were 50 in five states/UTs and 100 in 28 states/UTs.
• In the curriculum evaluation, generally marks were awarded in twenty states/UTs whereas marks were awarded for scholastic aspects and grades were awarded for co-scholastic aspects in twelve states. The continuous comprehensive evaluation was implemented in 16 states only.

**Strategies in the Plans for Elementary Education**

As elementary education is the base of the educational pyramid, it is important to ensure access to good quality education for all the sections of the population with special attention to the needs of the SC, ST, OBC and minority communities and girls. The 86th Constitutional Amendment Act, 2002 led to a new Article 21-A in Part III of the Constitution that made Free and Compulsory Education to all children of 6 to 14 years of age, a Fundamental Right. It is imperative to give good quality elementary education to all children in the age group of 6 to 14 years. The major schemes of Elementary Education sector during the Tenth Plan included SSA, District Primary Education Programme (DPEP), Mid-Day Meal Scheme (MDMS), Teacher Education Scheme and Kasturba Gandhi Balika Vidyalaya Scheme (KGBVS). Lok Jumbish and Shiksha Karmi Projects were completed. The XI Plan have addressed major challenges including bridging regional, social and gender gaps at all levels of education to meet the Millennium Development Goals viz.

• Achieve Universal Primary Education - to ensure that all boys and girls complete a full course of primary schooling by 2015.

• Promote gender equality and empower women - eliminate gender disparity in primary and secondary education preferably by 2005, and at all levels by 2015.

The strategy to achieve the above mentioned targets should consist of the following:

~ Cover 3.8 million children with special needs.

~ Eliminate all gender, social and regional gaps in enrolment, dropouts and increase retention by 2011-12.

~ Ensure substantial improvement in learning levels of children and also bridge regional, social and gender gaps in academic achievements.

In Twelfth Plan strategies for Elementary Education are as follows:

1. **SSA** will continue to be the flagship programme for developing elementary education during the Twelfth Plan for realising the rights to elementary education for each and every child. There would be
four strategic areas under SSA during the Twelfth Plan. These are: \((i)\) strong focus on learning outcomes; \((ii)\) addressing residual access and equity gaps; \((iii)\) focus on teacher and education leadership; \((iv)\) linkages with other sectors and programmes.

The RTE Act confers a permanent right to free and compulsory education of equitable quality on the children of India - for all times to come. It requires the whole education department to work together in a unified manner, and necessitates a fundamental change in the governance structure. It is, therefore, necessary to put in place systems and mechanisms for a shift from the SSA project-based approach to RTE.

Quality in education is inherently dependent on the following six aspects: \((i)\) curriculum and learning objectives, \((ii)\) learning materials, \((iii)\) pedagogic processes, \((iv)\) classroom assessment frameworks, \((v)\) teacher support in the classrooms, and \((vi)\) school leadership and management development. A new framework for curriculum is needed at regular intervals in order to take cognizance of the developing issues in society and how to address them. As education is concerned with all-round development of the child (physical, socio-emotional along with cognitive), all aspects need to be assessed rather than only academic achievement. During the Twelfth Plan, however, there will be a system-wide focus on holistic development of children by improving learning outcomes and other non-scholastic areas. Learning enhancement programme (LEP) under the SSA would be continued in the Twelfth Plan, for which specific zones of operation should be identified by the concerned State/District authorities. Every year, States need to articulate the learning goals that are being targeted and the strategies (methods, materials, models and measurement) that will be used to reach those goals. Institutional assessment/ accreditation of the elementary schools will be introduced in the Twelfth Plan, and possibly made mandatory from the Thirteenth Plan onwards.

\((A)\) Strong Focus on Early Years in School

\((B)\) Review of School Textbooks

\((C)\) Enhancing Facilities in Schools

\((D)\) Research for Quality Improvement

\((E)\) Pre-Primary Education

\((F)\) Moving From Grade-Level to Ability-Level

\(Teaching–Learning\)

\((G)\) Promote State-Level/Local-Level Innovation

\((H)\) Child-Friendly Assessment
1.3.3 Importance of Mathematics in Elementary Education

The spirit of modernity and development in nations is reflected in their investment in children’s education in general. If science education is often termed as societal investment in the envisioned future, education in the “high roads of mathematics” perhaps constitutes their hope for the as-yet dream of future. The landscape of mathematics education in India calls for a very broad vision to encompass and comprehend. It is not only a matter of scale and magnitude in numbers of children and teachers that constitute the system, but also messy but democratic modes of functioning in which there are pulls from many social and political aspirants of society. Everyone desires that every child to learn mathematics and enjoy it; the reality of achieving this with millions of children and teachers by democratic means provides a major systemic challenge. Now RTE guarantees 8 years of elementary education to every child in the age group 6-14 in an age appropriate classroom in the vicinity of his/her neighborhood. This implies the right of every Indian child to quality mathematics education as well.

The Quality Dimension

According to some Indian academicians the central challenge of Indian education is dealing with the metaphorical triangle of quantity, quality and equality. The state sector in education is plagued by major shortage and uneven spread of resources, as witnessed by the large percentage of single classroom schools. Such extreme shortage of resources presents a tremendous quality constraint. Much worse, and especially relevant to mathematics education, is lack of qualified and committed teachers. No system can rise above the quality of its teachers, and content knowledge of mathematics is vital for mathematics education. Set against this is the data that nearly 43 percent of teachers in India in elementary education do not possess a college degree of any kind, let alone in mathematics.

Indian society is division-riven and this provides a great challenge for quality and equality in education. Mathematics being a compulsory subject of study, access to quality mathematics education is every child’s right. On the other hand, there is considerable research (though not specific to mathematics classrooms) to suggest that teacher preconceptions, bias and behaviour, causes discrimination against children from the groups with low socio-economic status, the so-called “Scheduled Castes” (SC) and “Scheduled Tribes” (ST). Also the girls who do come to school are subject to social discrimination as well. In rural areas preconceptions such as mathematics being “unnecessary” for girls can be observed.
even among teachers. Despite the better performance of girls in Board examinations than boys in recent years, the stereotype that boys are better at mathematics than girls is seen to persist. The social context of Indian education is reflected in the sharp disparities between different social and economic groups, which are seen in school enrolment and completion rates. Thus, girls belonging to SC and ST communities among the rural and urban poor and the disadvantaged sections of religious and other ethnic minorities are educationally most vulnerable, and data confirm this.

Set against such a bleak picture is also hope, arising from several wellsprings of activity:

1. Against all odds and amidst extreme diversity, there are many children who take to mathematics and teachers committed to mathematics education. Statistically small, they still make up a large number given the size of the Indian population.

2. While social barriers are a great challenge, the confidence and energy released by overcoming them is very positive. Mathematics, being the discipline of thought without great need for texts, laboratories and other paraphernalia, and being the discipline that greatly inspires confidence and self-esteem, becomes then an instrument to break out of adversity for children from these disadvantaged sections, especially girls.

3. Southern India has seen how the growth of computing and Information Technology industry offers a sense of hope to people, and perhaps due to the popular perceptions of computing, to a surge in interest in mathematics education. Among this is a noticeable increase in the participation, in mathematics learning, of girls and children from underprivileged sections.

4. The educational reform process initiated in the last decade has seen a churning across the country within school mathematics, in terms of attitudes and approaches to it. While it is too early to tell whether these efforts will lead to radical shifts, the trend is positive.

5. Lastly, the use of technology, only recently coming in as a factor, may help India solve some of the systemic problems discussed above.

While mathematics was seen to be an essential part of any curriculum from early on, perspectives differed. The Zakir Husain committee in 1937 saw it in relation to work. The National Policy on Education in 1986 saw it as a “vehicle to train a child to think, reason, analyze and to articulate logically.” However, the shape of mathematics education has remained largely the same over the last 50 years. In response to global curricular processes in India too there has been considerable curricular acceleration in school Mathematics. For instance, calculus which was only taught in college three decades ago is taught now at the higher secondary level. On the other hand projective geometry has almost entirely disappeared from the school. At the undergraduate level, the core curriculum remains much the same, though the
influence of computer science and other modern disciplines can be seen in the course mix on offer. Over the end of the last century, a perception that mathematics education was increasingly becoming burdensome and ineffective had gathered momentum. The Report ‘Learning Without Burden’ (Ministry of Human Resource and development, 1993) had pointed out that children were in fact not ‘dropping out’ but were being ‘pushed out’, owing to the ‘burden of non-comprehension’, as a result of an irrelevant curriculum, distanced from the lives of the majority, and often rendered ‘boring and uninteresting’ by outdated teaching strategies.

The National Curriculum Framework, 2005 (henceforth NCF 2005) responded to this and guided the development of new curricula and textbooks based on how children actively construct knowledge, rooted in social and cultural practices [National Council of Educational Research and Training (NCERT), 2005]. The NCF 2005 position paper on the teaching of mathematics (NCERT, 2006a) begins by stating that the primary goal of mathematics education is the “mathematization of the child’s thought processes” and the development of the “inner resources of the growing child.” It goes on to argue for a “shift from content to process”, recommending a multiplicity of approaches, to liberate school mathematics from the “tyranny of the one right answer obtained by applying the one algorithm that has been taught”. It emphasized the need for processes such as “formal problem solving, use of heuristics, estimation and approximation, optimization, use of patterns, visualization, representation, reasoning and proof, making connections, and mathematical communication”. Subsequent to this, many Boards of education in the states undertook a curricular review exercise and the last few years have witnessed a shake. While the high-ceilinged goals articulated above may be hard to achieve, there have been some significant shifts visible in textbooks and pedagogic processes, especially in elementary education. However, secondary education, weighed down by the shadow of Board examinations, remains hard to reform. The end-of-school Board examinations remain landmark events in the lives of children, and as passports to economic mobility, they critically inform attitudes to education. These exams cast long shadows and inordinately influence classroom assessment. In fact, the traditional pattern of examinations in mathematics have been a matter of serious concern and have not only intimidated children but have often dissuaded more creative teachers too, since their classroom efforts to encourage sense making tend to get obliterated by the focus on procedural questions devoid of meaning and contextual relevance. In this context, the pressures of a democratic society on Board examination results have to be acknowledged as well. When single subject failures tended to be high in mathematics, the pressure to set exams that fail fewer pupils became strong. This has led to a situation where pass rates have increased among those who appear for Board exams, but many who give up, drop out much earlier. This also means that high achievement in many of these exams may not attest to high competence or mastery of the subject either. One solution to this has been attempted in many parts of the world, that of streaming students into Basic Mathematics and Advanced Mathematics,
with the former constituting mathematical literacy that the state considers essential for its citizens, and the latter dictated by disciplinary objectives. But this is problematic in India, since they can become yet another form of social discrimination, with the latter course simply not being offered in many schools which children from poorer sections attend. Indeed, this was the experience in many Indian states in which such streaming existed till the 1960’s. In a society that is already deeply riven by many social division, the possibility that the rights of disadvantaged children to quality education in mathematics might be destabilized presents a major problem. (Reference R. Ramanujam( 2012), Mathematics education in India – An overview)

1.3.4 Goals of Elementary Mathematics

The Position Paper of the National Focus Group on the Teaching of Mathematics (NCERT, 2006a) calls for a shift from achieving ‘narrow’ goals to ‘higher’ goals, from mathematical content and procedural knowledge to processes and learning environments that promote abilities for mathematization, which invite participation, and offer every child a sense of success. According to Sfard (2008), a ‘participationist’ vision of learning mathematics, unlike the conventional acquisitionist approach, acknowledges that learners begin by participating in collective mathematical discourses, of the home, community, or school, and progressively learn to individualize the discourse, as they communicate mathematically with themselves. The challenge of designing curricula for schools as diverse and aberrant as are in India, is therefore daunting, to ensure representation of diverse discursive mathematical practices, through critical pedagogies that enable democratic participation (Rampal, 2010). For, even the early math signifiers of ‘more’ or ‘less’ can have different meanings for participants positioned in particular ways. As has been noted by Walkerdine (1990), mothers of working class families frequently using the contrastive pair ‘more/no more’ rather than ‘more/less’, while strongly regulating consumption of basic commodities, tend to cause children to have strong negative associations with the term ‘more’, which are generally not understood by curriculum designers, who might naively assume mathematics to be ‘culture neutral’. Moreover, even the ways people construct and use mathematics as part of their lives, where to materially survive some cannot afford to go wrong in a computation, while for others it may afford a theoretical or even a recreational engagement, can relationally redefine the classic ‘concrete/abstract’ distinction. In the rights framework, it is recognised that quality is indeed tied to equity, which can be achieved only when there are high expectations from and meaningful opportunities for all children to perform well. Indeed in several countries the curricular goals for mathematics place the ‘equity principle’ high in priority, recognizing that this school subject has traditionally played the role of ‘gate keeper’ and contributed to high inequities in performance and participation, especially of
underserved, ethnic and disadvantaged groups, who are marginalized from the way school mathematics is structured. It has been seen that when the learning environments available to diverse groups are transformed, through more realistic, relevant and meaningful contexts, mathematical attainments become more equitable for all children, who show a greater sense of self esteem and confidence (Boaler, 2008; Nasir and Cobb, 2007). This equity framework challenges deeply entrenched beliefs in society that only some ‘talented’ students are capable of learning mathematics, and calls for a democratic restructuring of the purpose and nature of the school curriculum, as well as of what constitutes mathematical ‘talent’. The last few years have seen efforts in India to address this major challenge, and syllabi and textbooks have changed to some extent, though much of the task is still in progress. However, it is crucial to recognize that within the present state of resource starvation of most of our elementary schools, textbooks remain the only educational materials available for children. There are no concrete objects, games or manipulative in the classroom, and, even though NCF 2005 lays stress on this, teachers most often do not recognise the significance of such materials and processes for math learning. Curricular reform thus involves layered negotiation, within and outside the system, from policy documents to classroom practices, in states and at the national level, involving several key players such as administrators, teachers, parents and the media, to change mindsets about how children learn and how that may be assessed, and what basic provisions are essential to make schools conducive for that learning to happen. The Position Paper (NCERT, 2006a) proposes that mathematics teaching and learning should promote a multiplicity of approaches, crucial for liberating school math from the tyranny of the one right answer, found by applying the one algorithm taught. This focus is meant to make math enjoyable and challenging, through activity based learning processes of problem solving, estimation, optimization, use of patterns, visualization, representation, and mathematical communication, which play an important role in removing the fear of mathematics. There is also an attempt to draw upon the rich cultural resources of everyday and folk mathematics – for measurement, estimation, and understanding of shapes, symmetries and aesthetics - through contextual examples from art, architecture and music. As part of the National Curriculum Framework 2005, the syllabus developed by NCERT laid out the following curricular areas in a progressive web of concepts for the first five years of school: Geometry (shapes and spatial understanding), Numbers and numbers operations, Money, Measurement (length, weight, volume, time), Data handling, and Patterns. The syllabus recommends activities and exercises that span children’s life experiences across the curriculum of different subject areas, where extensions of the activities are also part of the main text materials. It underscores that mathematics is a way of thinking and reasoning and textbooks must use children’s local interests and enthusiasm for developing concepts, through an interactive approach that gives space for a child to articulate her reasons for choosing a certain strategy. Problem posing is acknowledged as an important part of doing math and calls for opportunities in the
textbooks and classrooms for children to create a variety of problems for their peers and others. It also states that textbooks be written in a language that the child would normally use and understand, with creative visuals, comic strips, cartoons, narratives, stories and other interesting texts. It emphasizes that it is not appropriate to begin with definitions and explanations but that concepts and ideas need to be arrived at by observation of patterns and exploration, before children can articulate in their own words. This is a significant shift from the traditional approach but has not yet been fully incorporated across the school curriculum, information.

1.3.5. Challenges to realising the goals of Elementary Mathematics Education

Though a lot of forward looking and significant changes have happened at the level of curriculum development and textbook writing, there are several challenges to be met to realise the goals of elementary education in mathematics. Some of these have to do with equipping teachers to cope with the demands the new curriculum places on them. There is also a need to review the new curriculum, particularly at the upper primary level, in order that it has something valuable to offer students who suffer the impact of socio-cultural and economic disparities, at home and in school, that limit their opportunity to benefit from the new curriculum.

The Upper Primary School - Curriculum design and implementation

A major challenge that goes beyond teacher professional development is more fundamental and has to do with designing a curriculum at the upper primary level. The NCERT syllabus for upper primary mathematics states that the emphasis is on “the need to look at the upper primary stage as the stage of transition towards greater abstraction, where the child will move from using concrete materials and experiences to deal with abstract notions”. Though there are significant differences between the approaches followed by different states, the curricular content of mathematics at the upper primary level remains similar, with a strong focus on imparting disciplinary knowledge. Typically the upper primary curriculum deals with rational numbers and their properties, algebra, geometry, data handling and ‘commercial mathematics’. Numbers and number systems deal with natural numbers, integers and their properties, decimals, rational numbers, their representation on the number line, factors, multiples, exponential notation, prime factorization of numbers, ratio, proportion, percentage, finding square roots and cube roots, including the algorithm for finding square roots. Generally algebra begins in class 6 with the introduction of symbols to stand for numbers. While the NCERT textbook limits itself to writing linear polynomial expressions and equations in one variable at the class 6 level, some state boards introduce higher degree polynomial expressions in two variables and the operations of addition and subtraction on them, ending with solving linear equations in one variable in class 6. By class 8, most of
the boards cover the three operations on higher degree polynomials in two variables, factorization or division and algebraic identities. Geometry is also formally introduced at this level. Traditionally, students have been struggling with notion of proof and the actual proofs of geometrical statements, which are mostly memorised. The new syllabus postpones formal proofs in geometry to the secondary stage, and instead lays emphasis on verification and reasoned justification. In geometry and measurement, the content begins with giving some idea of what geometrical objects such as points, lines and line segments mean, then moves onto polygonal figures, the notion of angle, using the geometry kit to measure angles, construct triangles, quadrilaterals, perpendiculars and angle bisectors, properties of triangles and quadrilaterals, circles, three dimensional objects namely spheres, cylinders, cones and pyramids. The formula for finding the perimeter, area and volume are either arrived at or given straight away depending on the school board. Apart from these three major themes, there is some exposure to data handling (pictographs, frequency tables, chance and probability, measures of central tendency, graphs) and commercial mathematics (profit and loss, simple and compound interest). A major cause for concern is however that state governments are slowly adapting the NCERT mathematics curriculum at the upper primary level, in spite of the socio cultural differences in the student population. Most rural children and those from socio economically marginalized backgrounds study in government run schools where the state curriculum is in force. A large majority of first generation learners from the marginalized sections enter upper primary school without achieving appropriate learning in primary mathematics. As mentioned earlier, the issue is complex as it involves teachers’ beliefs about the ability of the learners from rural or urban poor families and oppressed castes and their perceived need to learn mathematics, and calls for special training to teach children who have no support at home. While it is hoped that the newly enacted Right to Education Act for all children to get equitable quality education till they complete elementary school may bring in some positive change, the present learning levels have been known to be poor. It has been found that written mathematics poses serious challenges for deprived children, even though they may have some competence in oral computations and problems situated in contexts meaningful to them. Class 6 children are not able to write three digit numbers, and many cannot perform subtraction or carry out division. A few who managed to solve it did so by inventing their own symbol system to distribute and add up each child’s share. In another classroom trial it was observed that owing to poor training at primary grades, most class 6 students belonging to similar backgrounds had to be taught division afresh and they preferred the partial quotients method over the standard division algorithm (Khemani & Subramanian, 2012). In other words, at the upper primary level, these children bring into the classroom some knowledge of numbers learned from their everyday life experiences but very little from the previous five years of learning at school. The disconnect between these children’s encounter with numbers and the demands of school mathematics is something that is well studied and reported (Nunes, Schliemann &
Carraher, 1993; Lave & Wenger, 1991) and our experience with children from marginalised backgrounds resonates well with these studies. In general making sense of abstract number problems and algebraic expressions remains a major challenge for them as their training in mathematics has not enabled them to acquire these skills. Classroom interventions and close interactions with children show that most of them from lower socio-economic backgrounds have not learnt the use of the geometry kit. Angle measurement poses serious difficulty for many children. There are no suitable qualitative studies that focus on how children learn geometry and the challenges they face in different school situations, yet there is empirical evidence to believe that the content in geometry does not get transacted at all satisfactorily. A typical classroom transaction in mathematics could amount to the teacher working out a problem on the blackboard and the students copying with no comprehension. The upper primary classroom thus continues to alienate and remain effectively inaccessible for a large section of the socially marginalised student population and also for many from the urban middle classes (Subramanian, Umar & Verma, In Press). Teaching and learning of algebra and negative numbers remains a major challenge even in urban middle class settings. There has been some research exploring alternative approaches for the teaching of algebra by bridging the gap between arithmetic and algebra using ‘terms’ (Banerjee, Subramaniam, & Naik, 2008). In other words, in spite of the fact that the new upper primary mathematics curriculum is designed to enable children to explore, experiment and acquire reasoning skills, it remains impractical for a large number of classrooms in India. While a section of mathematics educators might believe that the problem lies only with the quality of the transaction in school, both at upper primary and primary, there are those who believe that the existing situation compels us to critically examine why we teach what we do at the upper primary level. In fact, mathematics educators concerned with social justice issues have engaged with similar questions (Ernest, n.d.; Gellert & Jablonka, 2007; Gates, 2001; Skovsmose, 2011; Greer, Mukhopadyay, Powell & Barber, 2009). Arguing that a narrow definition of mathematics guided by what mathematicians practice does not represent the multiplicity of mathematical practices in varied cultural contexts, they call for a critical appraisal of the aims of teaching mathematicians’ mathematics and ask how mathematics at the upper primary level could be redesigned to enable the learner to critically engage with the socioeconomic and cultural reality in which they are placed. A major challenge therefore is to revisit the upper primary mathematics curriculum to make it inclusive for all children, by reviewing notions of what constitutes meaningful mathematics learning and also to ensure that teachers use appropriate constructivist pedagogies to make classrooms active learning spaces for all. This will require serious critical engagement with the discipline of mathematics and curricular research that explores alternatives while also providing better models of teacher education and professional development, as has been indicated in this paper. It is hoped that in the coming years the National Initiative in Mathematics
Education (NIME) would gain momentum, to involve a wide network of persons from different areas of work, in order to address the challenges delineated here and to achieve further progress in this direction.


1.3.6. Programmes /Schemes to develop Mathematical Science in Elementary Education in India

With regard to initiatives on Science Technology Engineering and Mathematics (STEM) in India, the proactive measures initiated in the recent past are:

• **Innovation in Science Pursuit for Inspired Research (INSPIRE)**

  The program sponsored and managed by the Department of Science & Technology for attracting young talent to the excitement of a creative pursuit of science as a career option and building the required critical human resource pool for strengthening and expanding the Science & Technology system and R&D base in the country. INSPIRE Scheme includes three components: (a) Scheme for Early Attraction of Talents for Science (SEATS), (b) Scholarship for Higher Education (SHE) and (c) Assured Opportunity for Research Careers (AORC). The target is to enroll 0.2 million school children in the age group of 10 to 15 years, offer INR 5000 per child as scholarship and spread the awardees country wide (at least two students per secondary school during the next five years).

• **Kishore Vaigyanik Protsahan Yojana (KVPY)**

  It is an on-going National Program of Fellowships in Basic Sciences, initiated and funded by the Department of Science and Technology, Government of India, to attract exceptionally and highly motivated students for pursuing basic science courses and research career in science.

• **Homi Bhabha Centre for Science Education**

  It has been made the country’s nodal centre for Olympiad programs in mathematics and sciences. The programs aim at promoting excellence in science and mathematics among pre-university students. The interventions which have been made in the way of influencing the teaching and learning of mathematics have been in varied directions: curriculum development, interventions in schools and classrooms, in-service teacher training, nurture programmes to train students to build capacities to think mathematically and solve problems of various complexities, and popularization of mathematics, largely to attract students to take up higher mathematics.

**Curriculum and material development**
Some of the earliest attempts to improve teaching and learning of mathematics were in developing alternative curricular materials. The Khushi-Khushi series of books for teaching mathematics at the primary level developed by Eklavya, a non-governmental organization (henceforth NGO), based in the state of Madhya Pradesh and the material designed by another NGO, Digantar based in Rajasthan are two such examples. They associated closely with local schools and teachers and the communities they intended to work with. These attempts were premised on children as active learners and faith in their ability to think independently and create knowledge. They took into consideration children’s background (socio-economic, language, local traditions, culture, environment, etc.) in the designing of learning material, understanding that these factors influence learning of mathematics in specific ways and considered these as ways to make mathematics meaningful. These initial attempts were based on some understanding in the areas of child development, language learning and mathematical skills and abilities of children. They relied heavily on Piagetian stages of cognitive development and promoted constructivist and discovery based learning, used games and activities and helped students learn from concrete experiences or structured materials before moving to abstract concepts. However, teachers were given adequate space to change, modify and add to the illustrative material given in the text as per the needs of their classes and children. They paved the way for many subsequent interventions. Three distinct trends are seen in the designing of these interventions. One set of interventions used plenty of games and activities to introduce concepts and ideas as well as to strengthen procedures. The thrust of these interventions is the use of games and activities and less importance is given to sequencing of concepts across grade levels or ideas within a concept. The Eklavya group made attempts to combine the teaching and learning of different subject areas like language, mathematics and science (Khushi-Khushi, 1998) but this approach worked well only for the initial Grades 1-3. As the students went up the grades, the teaching of different subject areas had to be separated. The Grade 4 Khushi-Khushi has three books, half of one of these books is devoted to mathematics and in Grade 5, one full book is on mathematics. Eklavya’s effort, in particular, was a broad based effort in collaboration with the state education department, involved many mathematicians and scientists and aimed to impact the system and society directly. In the process, these initiatives conceptualized and widened means for supporting teacher preparation (pre and in-service). The School Mathematics Project started by the Centre for Science Education and Communication, University of Delhi (1992) was another systematic attempt to develop an alternative primary mathematics curriculum in schools. It involved teachers, educationists and scientists, and built on the experiences of Eklavya. This process inspired other groups in the country to take up similar exercises later on, and some state boards (like Kerala and Tamil Nadu) used extensive participatory processes by which large numbers of teachers were involved in textbook preparation and trialling. Another set of interventions has been based on the use of very structured materials in a systematic way, to gradually
build new ideas and concepts. Suvidya, a Bengaluru based NGO, developed materials for concepts which are more amenable to such treatment. Navnirmiti, a Mumbai based NGO, designed a range of materials to cover almost all concepts and ideas in primary mathematics, embodying the philosophy of learning by doing. Jodo Gyan, a Delhi based NGO, made further extensions in the same line to incorporate the philosophy of Realistic Mathematics Education and designed material and teaching learning trajectories accordingly. Centre for learning resources, based in Pune is another organization, which has worked extensively with primary level mathematics, developing simple low cost teaching material and teacher training packages for using these materials.

A third set of interventions is more conceptually driven, introducing the concepts gradually and in a logical sequence (does not strictly follow the Piagetian stages of child development), deepening students’ understanding through various activities aimed at clarifying the concept and related ideas and procedures (Homi Bhabha Centre for Science Education, a research institution in Mumbai). Mathematics educators like P. K. Srinivasan and Shailesh Shirali have contributed by writing books and primers with the aim to clarify the content and with numerous examples of interesting problems (e.g. Srinivasan, 2004; Shirali, 2000).

**The National Curriculum Framework 2005**

The preparation of NCF-2005 was a huge exercise and led to significant changes in the way one thought about teaching and learning of mathematics and the way textbooks for children were written. The framework clearly explicated a philosophy and an approach to teaching and learning and systematically tried to address social justice questions. It was guided by the Constitutional values of India as a “secular, egalitarian and pluralistic society, founded on the values of social justice and equality” (NCERT, 2005). It proposed five guiding principles for curriculum development: (i) connecting knowledge to life outside the school; (ii) ensuring that learning shifts away from rote methods; (iii) enriching the curriculum so that it goes beyond textbooks; (iv) making examinations more flexible and integrating them with classroom life; and (v) nurturing an overriding identity informed by caring concerns within the democratic polity of the country. The textbooks which were written after the NCF-2005 deliberations, include various voices and backgrounds of children and adults who surround them. The tone of the books is reader friendly and the books have many visuals, games, activities and open-ended tasks. This nation-wide exercise had tremendous influence on state level development of curricular document and textbooks.

**In-service teacher training and teacher education programmes**

The new National Curriculum Framework for Teacher Education (National Council for Teacher Education, 2009) seeks to address the challenges of quality and equity concerns in teacher education by
laying a strong and equal emphasis on three areas of teacher education, namely ‘foundation of education’ ‘curriculum and pedagogy’ and ‘school internship’. Some states have already started revising their M.Ed, and B.Ed curricula in accordance with the new framework. However, there is also a strong need to enhance the status of teachers and to see teacher agency as central to realising the reform agenda. The challenge is also in reaching out to and convincing middle class parents who ignore concerns about children’s learning in view of their own aspirations about future choices of employment. In connivance with the school management, these parents often scuttle any progressive change, by adopting textbooks (and even scruffy guidebooks with solved answers) to maintain status quo through the traditional approach.

Teacher education programmes across the country have not changed as a result of the nationwide deliberations during the formulation of the NCF-2005. They continue to be the weakest link in our education system. The Indira Gandhi National Open University made the first and almost the only attempt to run a teacher education programme for primary mathematics teaching with special emphasis on content and conceptual clarity. The School Mathematics Project, which was started by the Centre for Science Education and Communication, University of Delhi, was another attempt to work with primary mathematics teachers in schools. Sandhan, an NGO in Rajasthan, has been associated with two prominent programmes in the region, Shiksha Karmi and Lok Jumbish.

**Mathematics popularization activities and nurture programmes**

Leading mathematicians spread across the country in many national level institutions (Indian Institutes of Technology, Indian Institute of Science, Institute of Mathematical Sciences, Tata Institute of Fundamental Research, Indian Statistical Institutes, etc.), many individuals, and the National Council of Educational Research and Training contribute towards popularizing mathematics among students, teachers and the community at large. Ganit Mela and Metric Mela (mathematics fairs held in villages where adults are involved in answering questions raised by children based on estimation) organized in different parts of the country are some attempts to take mathematics to the community. In this country of great diversity, we also have a very promising group of students spread across the country and across grade levels. Initiatives have been taken to retain their interest in mathematics and motivate them to pursue a career in mathematics. Some such programmes Rural Mathematics Talent Search (RMTS), Mathematical Sciences Foundation (MSF) and the Mathematics Olympiad. These aim to promote independent thinking among students, make challenging mathematics accessible to them, show applications of mathematics in various walks of life and interact with experts in the field. The RMTS aims at identifying and nurturing talent in the rural areas of Orissa. It holds a mathematics competition at the grade 6 level, designed on the lines of the Olympiad competition. The selected candidates are trained for the next three years, meeting them
twice every year. MSF is involved in arranging innovative programmes related to the teaching, understanding, learning and application of mathematics at the school, college and postgraduate levels.

Similarly, teachers, teacher educators and mathematicians have made efforts to bring technology into the secondary and higher secondary mathematics classrooms to make that learning space lively and enjoyable – engaging students in problem solving, challenging projects and providing support to understand the abstract concepts dealt at this level.

1.3.7. Sarva Siksha Abhijan initiatives for Mathematics Education at Elementary Level

Broadly the activities under SSA for numeracy skill acquisition in early grades can be categorized into the following areas.

a) Preparations at national and state levels for improving quality of maths education in schools

b) Envisioning exercises at national and state level for better understanding about mathematics education

c) Material development for different activities

d) Training of trainers and teachers for maths related activities

e) Promotion of innovative 3 ‘R’s (Reading, ’Riting & ’Rithmetic) guarantee programmes in states

f) Diagnosis and remedial measures for children who need special assistance

g) Action research on basic numeracy related issues

h) Internal and external Learning Achievement Tests to track children’s progress

i) Quality monitoring for tracking children’s performance on a regular basis.

Some of the salient activities under each category are discussed below:

a) Preparations at National and State Levels for Improving Quality of Mathematics Education in Schools

Following initiatives have been taken at the National level for ensuring the acquisition of basic numeracy skills in early grades.

- The National Curriculum Framework (NCF 2005), Position paper on mathematics education (NCERT, 2006), Syllabus for Primary classes and the textbooks have emphasized the need for improving the quality of mathematics education in the early grades and have defined a joyful and activity based classroom process by mathematizing the thinking process of children to create interest in mathematics, help in conceptual clarity and thereby reduce the math-phobia among children.
• A National Resource Group (NRG) has been constituted to critically look at various quality related interventions including quality of mathematics education under SSA. The NRG has repeatedly discussed the importance of acquisition of basic literacy and numeracy skills in early grades and has encouraged involvement of different mathematics resource agencies for capacity building in states.

• A special cell named Group Arithmetic in the Department of Education in Science and Mathematics of NCERT has been formed to work on strategies for strengthening the early mathematics development programmes under SSA. This Cell has developed several mathematics learning aids, guidebooks, teacher training manuals and mathematics worksheets in this regard.

• SSA norms have been revised to accommodate recruitment of maths and science teachers, promotion of Learning Enhancement Programmes with focus on acquisition of basic literacy and numeracy skills, remedial teaching, etc. In the States and Union Territories (UTs), various types of activities are undertaken in this regard. In states like Andhra Pradesh, Tamil Nadu, Karnataka, Orissa, Jharkhand, Kerala, etc., there are strong mathematics Resource Groups at State level. They constantly interact with different mathematics Resource Agencies for preparing and facilitating various mathematics related activities. They keep outsourcing their expertise in various areas. In this process States/ UTs like Jharkhand, Chandigarh, Goa have developed good quality worksheets and mathematics teaching materials. States also organize various innovative Mathematics Promotion activities such as Metric Mela (Community Mathematics Festival in good number of states), large number of Mathematics Clubs in Karnataka and number of states, Mathematics Marathon in Chattisgarh, Mathematics Festival in some states, Seminars and Workshops in Mathematics education, etc. In Andhra Pradesh in recent years the following programmes are held:

• Conduct of Mathematics Melas at district and state level every year by Sarva Shiksha Abhiyan.

• Mathematics through projects as a pedagogical strategy for understanding mathematics concepts.

• Development of Mathematics Forums at State and District Level.

b) Envisaging Exercises at National and State Level for Better Understanding of Mathematics Education

• The Department of School Education & Literacy (DSE & L) of the Ministry of Human Resource Development (MHRD) through the Pedagogy wing of Technical Support Group (TSG) has exposed the State Pedagogy Teams to the best of resource materials, resource agencies and resource persons in the area of Mathematics education. Some of the materials include Voluntary Service Overseas’ (VSO) resource book on Mathematics Education, P. K. Srinivasan’s resource books on Maths Teaching,
NCERT’s publications, wide range of innovative teaching learning materials developed by different resource agencies, etc. National Workshops have been organized by the Ministry on Science & Mathematics Education, Resource Enhancement of Teachers, and Multi Grade Multi Level Pedagogy with focal point on quality mathematics education.

- The MHRD has also organized series of workshops for states through Resource Enhancement Programme (REP) in collaboration with Delhi University, and Non-governmental organizations to facilitate better understanding among members of State Pedagogy teams regarding different mathematics concepts.

- NCERT’s Central Institute of Educational Technology, Indira Gandhi National Open University, etc., develop and telecast various types of Mathematics Learning activities through their audio – visual channels to help the State Mathematics teachers and trainers in their envisioning and preparations.

- A majority of States are collaborating with the resource agencies indicated above to improve the quality of their mathematics education, especially in the early years. Similar steps have been taken by States for strengthening understanding, pedagogical preparations and performance of their trainers and teachers. They collaborate with the Mathematics Resource Agencies on a continuous basis.

c) Material Development for Different Activities

Many states have developed a wide range of materials for improving the quality of mathematics education, especially in the early years. Some of them include their curriculum documents in line with NCF 2005, syllabi, textbooks, teacher training modules, resource books on Mathematics learning, Mathematics Work books, Mathematics Worksheets, many states/ UTs have developed mathematics kits for the early years.

d) Training of Trainers and Teachers for Mathematics Related Activities

Every State/ UT develops annual teacher training plans and modules for capacity building of teachers through the annual in-service training (for all regular teachers) and induction training (for new recruits) under SSA. For this each State/ UT develops training modules on Mathematics at both Primary and Upper Primary level. They are generally based on children’s district specific needs and they guide the teachers on how to promote effective pedagogy for quality mathematics education. While developing the teacher training plans and training modules states take help from NCERT, Technical Support Group and different Mathematics resource agencies as indicated above.
e) Promotion of Innovative 3 ‘R’s Guarantee Programmes in States

The MHRD has been constantly encouraging States/ UTs to develop Learning Enhancement Programmes with focus on acquisition of basic literacy and numeracy skills among children in early years. Over the years, States/ UTs have increasingly realized the importance of early literacy and numeracy and have designed 3 ‘R’s guarantee programmes. Such programmes are initiated on a pilot basis in selected blocks. After some successful experimentation, such initiatives are expanded across the State/ UT to universalize acquisition of basic literacy and numeracy skills among children in the early years. More than 23 States/ UTs have already designed such initiatives. Among these most initiatives strive for early numeracy skill acquisition as well. In such initiatives, States/ UTs undertake Students’ Learning Achievement Tests in basic mathematics (Arithmetic) and Language to assess their learning levels. Through these they identify the learning difficulties in different concepts and also the students who need to be supported carefully. They grade the students, schools, clusters and blocks as per their performance in different subjects. Remedial measures are undertaken in an organized manner to develop appropriate learning materials, prepare teachers, and carry out 3 ‘R’s guarantee programme along with effective academic support and monitoring. At regular intervals children’s maths abilities are assessed to see that their performance improves over a period. Programmes such as Children’s learning Acceleration Programme for Sustainability (CLAPS) in AP, Activity Based Learning (ABL) in Tamil Nadu, Noottikku Noorroo in Kerala, 3 Rs Guarantee Programme in Maharashtra, Integrated Learning Improvement Programme (ILIP) in West Bengal, etc., have demonstrated significant improvement in the numeracy skills of children in early grades.

f) Diagnosis and Remedial Measures for Quality Mathematics Education

States/ UTs such as Tamil Nadu, Karnataka, Andhra Pradesh, Gujarat, West Bengal, Orissa, Chandigarh, etc., have well organized diagnosis and remedial measures to track performance of children in mathematics and language. In other states they assess the performance of their students through their regular tests in the school internally. NCERT has also developed verifiable and observable indicators for mathematics learning for class III level (for details write to the author). These indicators are being used by the States to set the tone for their mathematics classrooms as they enable the teachers and teacher support institutions to know how much children learn mathematics during their various mathematical pedagogical
processes. Presently NCERT is in the process of developing similar learning indicators for other classes (classes V and VIII).

g) Action Research on Basic Numeracy Related Issues

States such as Tamil Nadu, Andhra Pradesh, Chhattisgarh, Gujarat, etc. have promoted action research on difficult areas in Mathematics learning through DIETs, BRCs, teachers, etc., and have designed remedial measures based on the finding of such research studies.

h) Internal and External Learning Achievement Tests to Track Children’s Progress

The HRD Ministry has been insisting on establishment of systems in states for independent learning assessment of students. Other than the NCERT’s regular nationwide Learning Achievement Surveys, states are also collaborating with various research & resource agencies and NGOs for getting their children’s performance assessed. Some of the prominent agencies include Pratham (Mumbai), Educational Initiatives Private Limited (Ahmedabad), etc. Also the 41 monitoring agencies under SSA keep tracking the children’s performance through regular visits and reporting.

i) Quality Monitoring for Tracking Children’s Performance on a Regular Basis

SSA has strengthened quality monitoring through the NCERT’s Quality Monitoring Tools that collect feedback from states (from school up to state level). Learning Achievement in different subject areas are regularly tracked at different levels to ensure that States/ UTs manage to identify the learning difficulties and pedagogical issues from time to time and design quality improvement strategies to address such issues and problems. Performance of children in each class in different subject areas is tracked through this. Other than this District Information System on Education (DISE) also reports the learning achievement of students to an extent.

At present the Sarva Shiksha Abhiyan is encouraging all states and UTs to design organized learning enhancement programmes to improve the classroom processes in different subject areas at both Primary and Upper Primary level. Several large scale effective initiatives have been launched including 3 ‘R’s Guarantee Programme and Educational Quality Improvement Programme (EQIP) of Maharashtra, Integrated Learning Improvement Programme (ILIP) in West Bengal, Activity Based learning (ABL) and Active Learning Methodologies (ALM) in Tamil Nadu, Karnataka Schools towards Quality Education (KSQE) in Karnataka, Buniyad in Jharkhand, Neev in Uttarakhand, Aadhar in Himachal Pradesh,
Children’s Learning Acceleration Programme for Sustainability (CLAPS) in Andhra Pradesh, Gujarat Achievement Profile (GAP) in Gujarat, Nai Disha of Uttar Pradesh, Multi Lingual Education programme for tribal areas in Orissa and AP, Nootikkku Noorroo in Kerala, etc. In 2008-09 nearly all States/ UTs are gearing up for similar activities on the large scale with an aim to mobilise their classroom processes towards active pedagogy. But learning outcomes in Mathematics both at Primary and Upper Primary level as depicted by various independent learning assessment studies do not reveal a satisfactory situation in mathematics education at the elementary level. This makes one ask if these interventions are sufficient and appropriate to improve the mathematics learning skills of students everywhere as desired. It still calls for lot more thinking and preparations to achieve the SSA goals aiming for universal quality education in the 6 to 14 age group. Mathematical resource centers, universities and mathematicians need to think about it more and should explore strategies to improve the quality of mathematics education in the country. Not much research has been done in this area to appropriately and adequately address the problems in India.

In our society academic achievement is considered as a key criteria to judge one’s total potentialities and capacities. Hence academic achievement occupies a very important place in education as well as in the learning process.

1.4. School Education in West Bengal

Within the broad national Constitutional framework, there is a complex system of acts and codes to govern the educational process in West Bengal. Of these, some pertain specifically to School Education and provide the bedrock of school education policy in West Bengal, as well as the legal basis on which the structured the institutions that are involved in the processes and practice of education.

West Bengal’s Department of Education

The department was created in January, 1921, under the Montague-Chelmsford Reform Act of 1919, to give effect to the principle of Diarchy in provincial administration. After independence, the Education Minister holds charge of the state’s Education Department. After the Minister of Education, the highest functionary at the Secretariat level is the Secretary, assisted by the Special Secretary, Joint Secretary, Deputy Secretaries and Joint Secretaries. The Department is divided into the Departments of Higher Education, School Education, Technical Education and Training, and Mass Education Extension Departments. The Department of School Education oversees the work of the Directorate of School Education, Primary, Secondary, Higher Secondary, Madrasah, SCERT, and Directorate of Accounts. The main functions of the Department comprise of making policy decisions and framing rules regarding
primary, upper primary, secondary and higher secondary education, Madrasah education as well as education for linguistic minorities and backward classes, and all other related establishment matter, including those pertaining to appointment, conditions of service, and vigilance. In the Elementary Education comprised of primary (class I – IV / V) and upper primary (class V/VI- VIII) education, the syllabus and curriculum are followed by different central and state boards.

Central Board of Secondary Education (CBSE)

The CBSE, which began as an autonomous society in 1935, is now one of the two premier national boards. The CBSE works closely with the NCERT, and follows the National Policy on Education framework very closely. In West Bengal, the Kendriya Vidyalayas (KV’s) as well as many private schools follow the CBSE. The Board only grants affiliation to those schools that have obtained a No Objection Certificate (NOC) from the state government. The latter also has the power to issue temporary NOC’s, and a withdrawal of NOC by the state government results in cancellation of the school’s affiliation by the Board.

Council for the Indian School Certificate Examinations (CISCE)

The CISCE was formed in 1958 and is the only non-Governmental Secondary Education Board to be recognized by the Ministry of Education under the Delhi School Education Act of 1973. The Council is composed of representatives from Anglo-Indian Schools, other CISCE Board examining institutions and state institutions. Committees, including the Curricular Committee report their findings to the General Council for approval. West Bengal has the highest number of CISCE affiliated schools. Even though there are no regional offices, a branch office in Kolkata runs some teacher-training programmes.

The West Bengal Board of Primary Education

This was constituted on the basis of the West Bengal Primary Education Act, 1973, which was enacted to provide for better development and management of primary education in order to make it universal, free and compulsory. The Act sought to repeal the Bengal (Rural) Primary Education Act, 1930, the Bengal (Urban) Primary Education Act, 1963 and the West Bengal (Rural) Primary Education (Temporary Provisions) Act, 1969. On the basis of this Act were also constituted the District Primary Schools Councils for every district as well as Calcutta Primary Schools Council for the district of Calcutta. The West Bengal Board of Primary Education is an autonomous body corporate with perpetual succession and a common seal. It is entitled to acquire, hold and dispose of property, and enter into contracts for the purposes of the Act. The Board has the power to ‘guide, supervise and control primary education’. This includes providing by regulations, on the basis of the recommendations of the curriculum committee, the syllabus, the textbooks to be studied in primary schools. The Board also publishes, from time to time, a
list of books approved for use in primary schools, and makes regulations on all aspects connected with examinations. Apart from this, it also administers the West Bengal Board of Primary Education Fund.

The West Bengal Board of Secondary Education

This state splits its secondary Education Board into two separate organizations, administered under completely separate Acts. The first of these organizations is the West Bengal Board of Secondary Education administered by the West Bengal Board of Secondary Education Act, 1963. This Act sought to repeal the West Bengal Education Act 1950 and 1954. It is the Board’s duty to advise the State Govt. on all matters relating to secondary education referred to it by the Govt. The Board has the power to direct, supervise and control secondary education. This includes laying down the general policy for secondary education, instituting the secondary as well as other examinations, and administering the West Bengal Secondary Education Fund. The Board can also undertake the preparation, production and sale of textbooks.

The West Bengal Council of Higher Secondary Education

This is the second organization to handle secondary education in the state. It is administered by the West Bengal Council of Higher Secondary Education Act, 1975. As compared to the West Bengal Board of Secondary Education, this Council is a corporate body that runs the state’s higher secondary education system. The function of the Council is to advise the State Govt. on all matters relating to Higher Secondary Education referred to it by the State Govt. Therefore, it has the power generally to direct, supervise and control higher secondary education. This includes granting or refusing recognition to institutions; providing by regulations, on the basis of the recommendations of the Syllabus Committee, the curriculum, the course of studies to be followed; and prescribing textbooks to be studied in recognized institutions for the secondary and other examinations instituted by the Council. The Council also undertakes, with the approval of the State Govt., the preparation, publication and sale of text-books and other books for use in the recognized institutions.

District Institutes of Education and Training (DIET’s)

The quality of school education as well as the efficient and optimal use of available resources depends on the quality and professional competence of teachers. Teacher education and training therefore assumes an overarching importance in school education. Just as NCERT and NIEPA function at the national level and SCERT functions at the state level, DIET’s were conceived of to contribute to the development of teacher
training and education at the district level. Its functions include imparting pre-service and in-service training to teachers, acting as a district resource unit to provide resource support such as extension, development of teaching aids and evaluation tools, engaging in curriculum and materials development, and undertaking educational planning and management at the grassroots level. Its special target groups include women, scheduled castes and tribes, as well as educationally disadvantaged children. DIET’s are answerable to the state government regarding the fulfilment of specified targets and objectives.

**Primary Teachers Training Institute / Secondary Teachers Training College**

The academic control of the PTTI’s lies with the School Education Directorate and the SCERT, while the District Inspector of Primary Education, headed by the District Inspector of Schools, supervises them. The academic control of these B.Ed. colleges lies with the universities to which they are affiliated. However, in spite of the training institutes, there are many untrained teachers at both the primary as well as the secondary level. The quality of the faculty, duration of course and curriculum also need to be comprehensively examined, and follow-up of pedagogical principles and transactional processes in actual classroom situations needs to be strengthened. The importance of developing standard teaching materials and effective teaching methods, followed by extensive teacher orientation was reiterated in a report of the School Education Committee.
Figure 1.2: Structure of Education in West Bengal
1.5. Emergence of the problem

The Indian education landscape saw significant developments during the 11th Plan. There was a surge in school enrolments, and gender and social category gaps in enrolments narrowed considerably. Expansion of school infrastructure and facilities significantly widened access to schooling, and incentives and child entitlements, such as textbooks, mid day meals and uniforms began reaching a considerably large number of children.

The most significant development, however, was that Article 21-A, inserted in the Constitution of India through the Constitution (86th Amendment) Act, 2002 to make elementary education a fundamental right, and its consequential legislation, the Right of Children to Free and Compulsory Education (RTE) Act, 2009, became operative on 1st April 2010. This development has far reaching implications for elementary education in the years to come: it implies that every child has a right to elementary education of satisfactory and equitable quality in a formal school which satisfies certain essential norms and standards.

The RTE Act incorporates the principles of child centred education spelt out in the National Policy on Education (NPE), 1986/92 and elaborated in the National Curriculum Framework (NCF) 2005; these have now become part of educational legislation. Government has since revised the Framework of Implementation for Sarva Shiksha Abhiyan(SSA) to correspond with the provisions of the RTE Act, as also the fund sharing pattern between the Central and State Governments to provide for a more favorable sharing ratio for the States. Notification of teacher qualifications under section 23 of the RTE Act and the prescription of a Teacher Eligibility Test (TET) by the National Council for Teacher Education (NCTE) were other significant developments pursuant to the RTE Act becoming operative in the country. Several initiatives were also taken in the States to support the RTE Act, including that: (a) 20 States notified the RTE Rules, (b) 31 States issued notifications prohibiting corporal punishment and mental (SSA) to correspond with the provisions of the RTE Act, as also the fund sharing pattern between the Central and State Governments to provide for a more favorable sharing ratio for the States. (c) 25 States issued notifications prohibiting screening for admission and capitation fees; (d) 31 States issued notifications prohibiting expulsion and detention; (e) 30 States issued notification banning Board examinations till completion of elementary education; (f) 27 States notified academic authority under RTE Act.

Improvement in learning achievement levels cuts across the gender and social categories, though there is gap in respect of SC and ST children. The National Curriculum Framework -2005 has clearly pointed out ‘a majority of children have a sense of fear and failure regarding Mathematics . Hence they give up early on and drop out of serious mathematical learning . Many a time the tendency embedded in teaching is to accelerate children mathematical skills by teaching them mechanical rules at the expense of understanding and intelligence applications. Therefore, there is a need to help the children learn
mathematics in a way that develops liking and understanding of mathematics during the early years of schooling particularly in classes I-VIII. A nationwide sub program to Sarva Siksha Abhijan (SSA) ‘Padhe Bharat, Bbadhe Bharat’ is planned in a twin track approach (i) to improve language development by creating an enduring interest in reading and writing with compression and (ii) to create a natural and positive interest in mathematics related to the physical and social world. In our society academic achievement is considered as key criteria to judge one’s total potentialities and capacities. Hence academic achievement occupies a very important place in education as well as in the learning process. Several initiatives have been undertaken in Sarva Shiksha Abhiyan for improvement of quality in mathematics learning in the schools. Universalization of schooling has important implications for mathematics curriculum. Mathematics being a compulsory subject of study, access to quality mathematics education is every child’s right. Every citizen wants mathematics education that is affordable to every child, and at the same time, enjoyable. With many children exiting the system after Class VIII, mathematics education at the elementary stage should help children prepare for the challenges they face further in life. In this context, the present researcher will try to find the level of achievement of mathematics at the end of elementary education.

The variation among students’ achievements in different component of mathematics may be due to the lack of interest or much more interest or due to the lack of concept or enriched concept whether it maybe. So, the students may not interrelate among different component of mathematics. But the perception of interrelationship among different component of mathematics among students is very important. So, in this study it will be observed the level of achievement in different component of mathematics.

Gender issue has become the talk of today’s forum. Although the literacy rate is more among boys than girls, it is quite interesting to observe that girls are securing better ranks than boys in almost all competitive examination. From the last ten years, it is very fascinating to find note the girls figure to be more often in top ten two ranks in tenth class annual examination. Thus the present study is an attempt to find out the grade difference, if any, in the achievement level of mathematics at the end of elementary education.

During the life span of an individual, adolescence is a stage highly influenced by so many things around the world. Adolescents are highly influenced by society, socio-economic status, self concept, study habits, emotional maturity etc. which may disturb the achievement of adolescence in high school period. In this regard the researcher will try to find the achievement levels of students in mathematics and find the causes of underachievement in mathematics, if any, at the end of elementary education.
Competition seems to be a central focus in our society today. No matter where one goes or what one does, one's age or occupation, there seems to be an emphasis on competition. The world of education is no exception. There is competition at every level and in every phase of education today from high school students competing to get into the best colleges, to teachers competing for merit pay, and to schools competing on standardized achievement tests. Pressure on educators to compete comes from many levels. Pressure on educators to compete can also come from parents, colleagues, and administrators, as well as from various local, state, and federal institutions. The overwhelming message to teachers throughout the country is to "get the scores up." In addition, there is pressure on educators to establish a good reputation for their schools within the community. At interschool athletic events, in grocery stores, and wherever parents meet, they discuss and compare schools: which has more computers, which has the best programs, and most of all, which schools rank highest on the standardized achievement tests.

On the other hand, it would be nearly impossible for teachers to develop the underlying concepts that should accompany all the new skills by testing time. Teachers may respond to the pressure to "raise the scores" by deciding to cover the material quickly and lightly in order to cover it all by the time the test is given. Concept development may, therefore, receive only secondary emphasis. After all, concept development is usually not only more time-consuming in the classroom, it is more demanding in terms of the planning, preparation, and patience needed to incorporate "hands-on" and application experiences necessary for thorough concept attainment. And, in the end, 'real' learning or concept development may not be rewarded when the scores "come out." The scores may more likely reflect the breadth of learning rather than the depth. For progress to be made in basic skills, students must develop a strong foundation of fundamental concepts. And, it is the elementary school teachers who assume the responsibility of carefully establishing those fundamental learning. This seems particularly concepts necessary for future need for careful concept development important in mathematics because every new skill or concept introduced is dependent upon the thorough understanding of previous skills and concepts. Sequential skill building and the careful connection of concepts are essential to students' future success in mathematics. But, if teachers are under pressure to rush through the curriculum in order to meet testing deadlines, they may not be able to meet their responsibilities properly. They may not take the time to develop the fundamental concepts or the higher level cognitive skills such as analysis, reasoning, or creative problem-solving which the tests do not typically measure. They may spend their time sharpening the testable skills. Instead of being determined by sound guidelines and the amount of time students need to conceptualize the material, the sequencing, pace and presentation of many elementary-school mathematics programs may be determined by when the standardized achievement test is given. Specifically, this study will assess the students achievements in mathematics at the end of elementary education with regard to these issues through use of a standardized test.
1.6 Conclusion

The rationale for mathematical achievement has four dimensions. Firstly, for the foreseeable future, science has a key role to play in helping reduce inequalities. Without a basic mathematics education, people are unable to participate fully as citizens. The second dimension is that basic school mathematics introduces students to one of the great achievements of the modern world. It also makes a particular contribution to developing powerful ways of thinking within science including mathematics and, more importantly, beyond science and mathematics. Students begin to acquire a valued and valuable part of culture. Thirdly, in the world of work, basic school mathematics increases the freedoms to choose a wider range of careers, careers that are more financially and personally enriching. The fourth dimension is increasing globalization. This brings with it challenges, potentials and possibilities; to better meet these, students need at least a basic mathematics education.

It is urgent to propose substantial developments in the science and mathematics that students learn in school, with implications for teachers, policy makers and governments. A proposal for a humanistic school mathematics should be developed that will challenge educational systems, not so much in the content of the curriculum but in the way that learning in schools is brought about. This elementary mathematics education will contribute to a more equitable world, where students are prepared to achieve their potential, to contribute to society; students are introduced to powerful ways of thinking about the world. They are prepared to take their full place in that world and to change their worlds for the better. For those reasons, the researcher had chosen the study to find achievement level in mathematics of the students completing elementary education and that’s all for emerging of the problem.