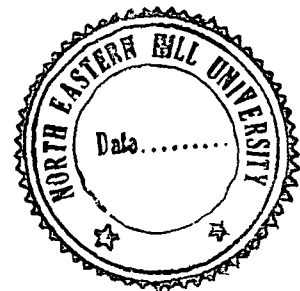


**A Critical Survey of Present Status  
of Plus - Two Mathematics  
in Meghalaya**

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DEPARTMENT OF MATHEMATICS

**Submitted in partial fulfilment of the requirement  
of the Degree of Master of Philosophy**

TO



**NORTH-EASTERN HILL UNIVERSITY  
SHILLONG**

**July 1988**



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30TH JULY 1988

This dissertation "A Critical Survey of Present Status of Plus Two Mathematics in Meghalaya" has been prepared by Nivedita Roychowdhury, under my guidance. This is an independent work and was not submitted for any degree or diploma of any University.

(B. K. Devsharma)  
Supervisor



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ACKNOWLEDGEMENT

I owe a deep sense of gratitude to my Guide, Dr. B.K. Dev Sharma, Director, Centre for Distant Education, North-Eastern Hill University, for his brilliant guidance and constant encouragement, without which the present study would not have been completed.

I wish to express my thanks to the staff of the SCERT Office, the Examination Section, NEHU, and the Offices of all the Colleges of Shillong who helped me in collecting materials. I am also thankful to the teachers and students of mathematics of the Colleges of Shillong for their cooperation.

I am also indebted to Mr. Joseph F. Khongbuh, Stenographer, CIEFL Regional Centre, Shillong, who took all the trouble to type this work.

I owe a debt of thanks to all persons who have rendered valuable help directly or indirectly in the completion of this work.

SHILLONG

THE 30<sup>th</sup> JULY 1988.

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## Synopsis

### A CRITICAL SURVEY OF PRESENT STATUS OF PLUS TWO MATHEMATICS IN MEGHALAYA

The present educational system not only in Meghalaya but also in the country as a whole, originally began on an altogether different objectives. It was introduced by the Britishers to train only the administrative manpower to meet the requirements of the government machinery. Mathematics was taught specially at school level, because it was practical and necessary for day-to-day life just to keep some accounts etc. only. Even after independence, although various changes have been made through the suggestions and recommendations of Education Commissions set up by the Government of India, the status of mathematics education in Meghalaya has not been marked by radical changes until recently, particularly at school level. As a result, Meghalaya which is a predominantly tribal state, has till today, a high percentage of dropouts in Mathematics. At plus two level, there is a meagre percentage of students opting mathematics as one of the subjects.

True, school mathematics upto +2 level is basic to undergraduate, postgraduate and research mathematics apart from it being fundamental to all scientific and technical education. Rather, its influence goes far

beyond, since the present, status of mathematics education determines the future technical manpower, and intellectual climate in the state as well as in the country. The way the students learn school mathematics and the culture they form now in learning it will ascertain the technical manpower in the future. Meghalaya though full of potential has failed to contribute remarkably towards the developments of the country because of its lack of technical manpower. The number of technically trained persons with sound mathematics background has been too low in the state to meet the actual requirements of the area. Under the circumstances, it is therefore considered essential to investigate the reasons behind the high percentage of dropouts in mathematics, and to analyse the causes the students of the state. With this objective, it is tried here in the thesis to carry a survey work on the teaching-learning system of mathematics at plus two level (here it is Pre-University level) which is a key link to general college education and other professional studies. An attempt has been made in our work to find out the causes of low input in mathematics at plus two level and henceforth, and to suggest remedies for that. The work is mostly concentrated on finding out the various issues of the teaching-learning process in mathematics at plus two level thrashing out the problems in it and

also to suggest a tentative programme of action consistent with the local conditions of the state.

The scheme of the work is divided into five chapters. The first chapter deals with the background and developments of Mathematics Education in India Meghalaya in perspective of mathematics education in India and the world. The status of Mathematics Education in perspective of New Education Policy is also discussed.

The second chapter concentrates mainly on the present status of Mathematics teaching and learning in Meghalaya at +2 level. Investigations and reports are presented here to discuss the achievement in Mathematics teaching-learning processes at plus two stage in Meghalaya with special reference to Shillong in last few years.

The third chapter is a detailed study on the nature of existing plus two curriculum in Mathematics. Its validity and drawback, its linkage with HSLC and degree syllabi, its accordance with the prescribed textbooks etc. are discussed in this chapter. It also focuses on the methods of teaching, problems and defects of teaching-learning process and various activities inside and outside the classroom.

The fourth chapter shows an analysis of plus two mathematics education of the state which is based on the views of the teachers and the students of Shillong on the existing teaching-learning process. The data is collected through a set of questionnaires prepared for remedies.

Suggestions and remedies are presented in the last chapter (Chapter Five) in order to improve the situations in Mathematics education in the state at plus two level. It is observed that the drawbacks which are there in the system can be classified into three categories viz. socially, individually and institutionally. All these three classes of problem are discussed in thread bare and possible remedies are suggested to each class of problem.

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CHAPTER - I  
INTRODUCTION

## INTRODUCTION

### 1.1 BACKGROUND OF MATHEMATICS EDUCATION

#### 1.1.01 History of Modern Education Vis-a-Vis Mathematics Education

The history of modern education in India began with the introduction of English education which brought about an educational transformation in the country in the 19th Century. The 18th Century only witnessed a shabby beginning of English education in India. But with the opening of the 19th Century there seems to be a 'gold rush' for getting English education specially among the elite Hindus. With a view to satisfying such need, schools for teaching English were accordingly established in Calcutta and its neighbourhood. Some knowledge in English was imparted in these schools but no systematic course of instruction was given. However, it is said that the beginning of Western Education was started with such movement.<sup>1</sup>

The most important event in the history of English education in India during the early period of 19th Century was the establishment of Hindu College later known as Presidency College, in Calcutta in January 1817. It was, in fact, a non-official and a non-missionary enterprise. David hare was the originator of this enterprise and the students of the Hindu College took a leading part. Consequently, the spirit of establishing new schools

spread over the area, and by 1831, morning schools in different parts of Calcutta happened to be established. The most noteworthy point in this regard is that these schools used to teach English literature, English Grammar, Mathematics, Astronomy, Geography, Chemistry, Philosophy, History, Painting and various arts including crafts. Thus, the formal teaching in the pattern of Western educational system was inducted to India by the ardent desire of a class of Hindus.<sup>2</sup>

Meanwhile, Lord William Bentinck became the Governor General of India in 1828 A.D. He was in favour of using English in every field of Government activity. In a letter written in 1829 A.D., the Court of Directors reiterated the policy of spreading English in India although the General Committee of Public Instruction from Government's side was not in favour of introducing English. But finally with the intervention of Lord Bentinck teaching of English language was introduced almost in all colleges imparting oriental education in 1833 A.D. Arrangements were made to teach English in Sanskrit college in Benaras as well as in Madras in Calcutta and Agra. Two English schools were established in Delhi and Benaras. Physiology and Euclid's geometry began to be taught in these schools.<sup>3</sup>

The distinctive feature of the period extending from 1813 A.D. to 1833 A.D. in the history of education

in India lies in the fact that a class of Indians including some leaders had acquired more or less a clear conception of education. They unanimously agreed that European knowledge together with the knowledge of Western science were to be introduced in India. But that was a very tough time; because, the entire education system was under the influence of oriental system and content with Sanskrit texts and 'shastras'. The question of introducing the new pattern of education in the country became a problem for the government since the Government was still hesitant to introduce mass education in India. On the other hand, it was also impossible to introduce the Western education in local languages at that time. Finally, it was taken as a settled fact that the new education could not but be taught through English or Sanskrit or Arabic or Persian dialect. Raja Ram Mohon Roy and other leaders pleaded to spread the new education through English language only for economic gain.<sup>4</sup>

At this juncture the British Government took a mischievous policy. They followed the filtration theory of education. As a result they paid attention for the education of higher classes of society, depriving the people in general. But prior to it, the Charter Act of 1813 added a beautiful clause empowering the missionaries

fully to come over to India and spread education in the land. The clause annexed to this effect was that a sum of not less than one lac of rupees each year shall be set apart and applied for the revival and improvement of literature and the encouragement of the learned natives of India and also for the introduction and promotion of a knowledge of the science among the inhabitants of the British territories in India.<sup>5</sup> In fact, this clause laid no foundation of science educational system in India. Besides, the works of missionaries in the sphere of educational system aroused a sense of blemish in the hearts of the Indians themselves as a result of which both state and private educational institutions began to sprout in the country and a well organised modern educational system came into existence.

#### 1.1.02. **The Charter Act of 1833 A.D.**

After the expiry of twenty years the Charter Act of 1813 A.D. was renewed and modified by that of 1833 A.D.<sup>6</sup> According to the contents of this charter, the missionaries of other countries also got full freedom to carry on their work in India. Further, it also announced the famous principle that "no native of the said territories, nor any natural born subject of His Majesty's resident therein, shall by reason only of his religion, place

of birth, descent, colour or any of them be disabled from holding any place, office or employment under the said Company". This measure naturally resulted in an uninterrupted growth of English education among all classes of society. The Charter empowered the Governor of Bengal Presidency to exercise his control over the rest of the provinces of British India, and thus fully authorised him to direct the educational policy of those provinces as well. The educational grant was increased from £10,000 to £1,00,000 which strengthened the hope of further educational expansion. The Charter added a fourth member (Law member) to the executive council of the Governor General and it was Lord Macaulay who was the first Law Member to be appointed. He added an important chapter to the educational history of India.<sup>6</sup>

#### 1.1.03 The Period 1835 A.D. to 1853 A.D.

Macaulay's Minute asserts a revolutionary changes upon the Indian education system on March 7, 1835. It asserts that:

- (1) The great object of British Government is to promote European literature and sciences in India. Hence all educational funds should be spent on English education.

- (2) The oriental institutions should not be abolished. Their teachers should be given salaries and students' stipends as before.
- (3) In future, books on oriental language should not be published for money had inordinarily been spent on them.
- (4) The money saved in this manner should be utilised in the work of disseminating English literature and sciences among the natives of India through the medium of English language.

On the basis of Macaulay's Minutes the educational policy of the country had finally been given a definite state and shape. Hence the Minute holds pre-eminently a very important place in the history of Indian education.<sup>7</sup>

After Macaulay's Minute there came Adam's report which advocated for the growth of proper secondary education through mother tongue. He even advocated to teach science through regional language.<sup>8</sup> However, it can be said that the period upto 1857 right from Macaulay's Minute could create good number of missionary schools, specially with the sound policy of Lord Hardinge who became the Governor General of India in 1843. Lord Hardinge wanted to make higher education popular by offering opportunities for Government service. As many as 101 institutions were established in Bengal, Bihar and Orissa in pursuance of the

resolution of Lord Hardinge. The striking feature of these Hardinge school were that mathematics was introduced as one of the major subjects in these schools.<sup>9</sup> Teachers were paid by the Government and arrangements for training the teachers were made. A Normal School was established at Calcutta in 1847. But it was unfortunate that the scheme of Lord Hardinge did not succeed in the practical field. The village people suspected Government's efforts in the field of education as a result of which only 26 schools, out of 101 could survive by 1852. Meanwhile, some Indian reformers like Iswarchandra Vidyasagar came forward for the rescue of 'Hardinge Schools'. With the effort of Vidyasagar two free schools came into being in 1853.

In the meantime Lord Dalhousie happened to become the Governor General in 1848. He followed the policy of Lord Hardinge in the matter of education. Besides, he tried to find out the causes for failure of primary education and desired to have new schemes on it. As a result, secondary school education emerged out successfully and the field of expansion of higher education became fertile. Many colleges were established to meet the growing need for English education. But the main drawback of the system was that literature and language were mainly emphasized without taking care of technical and scientific

subject. In other words, the importance of mathematics as an important subject was totally ignored.<sup>10</sup>

However, with the end of the period from 1835 to 1853, the controversy over the issue of medium of instruction having reigned well nigh for half a century, came to close, and Indian education was eventually saturated thoroughly by English ideals. Though progress of education was not satisfactory certain principles, no doubt, were definitely established during the period. For instance, the Government was forced to undertake the responsibility of mass education. Provisions for proper inspection of education had been affected and the Government had to announce their educational policy unequivocally and openly. Besides, the predominance of the filtration theory of education, negligence shown towards indigenous education in oriental and vernacular language, spread of Western education, especially English, the state policy of religious neutrality in the field of education, and lastly, encouragement given to private venture in educational sphere were some of the paramount features of the period.

It is, however, to be noted that every Province took interest in its educational venture and continued experiments in the sphere of education. By the end of

this period the Government had realized that the question of education in India could not further be postponed or avoided and that there was an urgent need of some definite plan in that direction. Along with the controversy over the issue of medium of instruction, the Orientalists Occidentalists controversy also came to a close. The Government of India, therefore, wanted to take definite steps in the direction of Indian education framing some comprehensive plan for the purpose. Ultimately, it came in the form of Wood's Despatch in the year 1854.

#### 1.1.04 WOOD'S DESPATCH

Although Wood's Despatch is often described as the Magna-Carta of the English education in India, the view does not appear to be true in all respect. It appears that the Despatch helped the Government to make the way for exchange of raw material with finished group. Besides, it provided the Government an opportunity to run Indian administration at low cost by creating a class of educated low paid officers. It . . . helped neither to mould the national character of Indian people nor to propagate the desired scientific education.

However, the impact of Wood's Despatch on educational growth can hardly be denied. On the strength of the Despatch a department of education came into being in

every Province. Three Universities were also established at Calcutta, Bombay and Madras. An Indianization of education was taking place. But these Universities could not serve India in the proper spirit. Due to the lack of vocational education as well as the proper science education, the country lagged behind in the industrial progress. As a result, technological outlook could not be produced and it could never demand the need for relevant mathematics to be inducted in the educational system.

#### 1.1.05. THE HUNTER COMMISSION

Although Wood's Despatch referred to vocational education (that too for higher classes), the educational system followed in India had an inherent defect, namely education was too bookish. As English was the medium of instruction there were no opportunities for preparation of curriculum and textbooks. Besides, it was difficult to introduce anything new unless it was permitted by the British authority. Consequently, science and technology was introduced only after the Hunter Commission in 1882.<sup>11</sup> But the Hunter Commission's recommendations did not succeed. It seems that there was lack of money; the prevailing educational system was immature; the political situation in the country was full of conflict and above all, the system suggested by the Commission did not suit the Indian

condition. However, this pattern of education continued to be in India upto 1902.

Meanwhile the sense of nationalism and social consciousness grew in the minds of Indian people which touched the field of education also. Expansion of secondary education during this period (from 1882 to 1902) resulted in the spread of College education. Pupils were more eager for college education than for vocational education. As a result, University education was found to sprout and quite a few Universities came up during this period. The rapid expansion of higher education can be judged from the following table.

**Table - 1: Growth of Colleges During 1882-1902**

Year	No. of affiliated colleges established	
	1st Grade	2nd Grade
1882	49	19
1882-1891	30	31
1892-1902	10	40

But the sad part of this rapid growth of higher education was that the standard of the collegiate education went down and the problem of unemployment of the educated class started. It may be mentioned that science education was not much stressed. The degree examination in Science

was not popular, which can be seen from the examination conducted under the Madras University in 1901-02 A.D. where only thirteen students appeared.<sup>12</sup>

#### 1.1.06 UNIVERSITY COMMISSION 1902 AND ITS IMPACT UPTO 1920

At the instance of Lord Carzon the University Commission was appointed on January 27, 1902. The purpose of the Indian University Commission was formulated as follows:

"To inquire into the conditions of prospects of the Universities established in British India, to consider the report upon any proposal, which have been or may be made for improving their constitution and working and to recommend to the Governor General in Council such measures may tend to elevate the standard of University teaching and to promote advanced learning."<sup>13</sup>

On the recommendation of the Commission the Indian University Act 1904 came into being on 21st March. The act was strongly opposed because of the facts that it could not reflect the educational interest needed for the society. However, its virtues and limitations brought about many an admirable improvement in the sphere of higher Indian Education. The efficiency of the colleges improved and the standard of education rose to some extent, although it did practically nothing for the betterment of science and mathematics education.<sup>14</sup> Then came the most

famous Swadeshi Movement, the impact of which ushered upon the Indian mind the plans for the propagation of National education. The National Council of education was formed under the leadership of Sir Gurudas Banerjee, Rash Bihari Ghosh and Robindra Nath Tagore. The Council chalked out a detailed scheme of National education ranging from Primary to University education including a technical institute which ultimately emerged out as Jadavpur College of Engineering and Technology. However, it can be said that the National Council of Education worked in the direction of reviewing ancient Indian culture and civilization. As a result, the Western Science and technology education was not inducted to a desirable extent. On the other hand, the then Government of India came forward to tackle the educational system more effectively. On September 14, 1917, the Government of India, through a resolution appointed the Calcutta University's Commission empowering the Commission to inquire into the educational condition of all the universities of the country.<sup>15</sup> The noteworthy suggestions put forth by the Commission can be summarised as follows:

- (1) Intermediate classes should be separated from University and curriculum spreading over three years should be prescribed for the degree B.A. The

stage for admission to the University was to be intermediate and not matriculate examination.

- (ii) Intermediate Colleges should be established for the sake of completing the first stage. The Colleges should conduct teaching in Arts, Science, Medicine, Engineering, Education, Agriculture and Commerce.
- (iii) A separate high school and intermediate board should be formed in every province consisting of representatives of the Government Universities, high schools and intermediate Colleges for the sake of managing secondary education. Recommendation were made to free the board from the control of the department of education.

Thus it seems the principal aim of the Commission in forming the board was to free the Universities from the responsibilities of the secondary education gaining over the system to bridge the wide gulf existed between the University and the education department. The Commission further recommended the use of mother tongue as the medium of instruction upto the intermediate colleges. In fact, this decision indirectly came on the way of propagation of science and mathematics education inducted from western stream though a new light on University education in India, particularly on the social science stream.

1.1.07 AN ERA OF EDUCATIONAL REFORM (1921 A.D. TO 1937 A.D.)

During this period, satisfactory improvements and expansion specially in University education took place. Above all notable progress was made in the fields of secondary education. At the advice of the Central Advisory Board (1921 A.D.) and the Hartog Committee (1935 A.D.) a new stage, known as the higher secondary stage came into being in the education system.<sup>16</sup> The higher secondary stage covered the schools with the definite purpose of

1. preparing students for admission to Universities in Arts and Science;
2. for training teachers for the rural areas;
3. for training in agriculture;
4. for clerical training; and
5. for training in selected technical subjects to be chosen in consultation with the authorities.

But this structure also could not enhance the spirit of science education and so of mathematics education in India. Even in the vocational education, the importance of mathematics was not stressed.<sup>17</sup> A clear impression of the remark can be seen from the table showing the numbers of scholars admitted.



**Table - 2: Growth of Education in Different Direction in British India**

Categories of College	Number	Number of Students
General Education	167	97,554
Law	16	6,883
Medical	10	5,330
Training	23	1,901
Architecture	7	2,253
Agriculture	7	3,263
Commerce	2	75
Industry	2	74
Forestry	4	492

**Table - 3: Growth of Education in British India from 1921 A.D. to 1937 A.D.**

Types of Institutes	No. of Institutes		No. of Scholars	
	1921-22	1936-37	1921-22	1936-37
Universities	10	15	Figures not available	3,697
Art Colleges	165	271	48,418	86,273
Professional Colleges	64	75	13,662	20,645
Secondary Colleges	7,530	13,056	11,06,803	22,87,872
Primary Schools	1,55,617	1,92,244	61,09,752	1,02,24,288
Special Schools	3,344	6,647	1,20,925	2,59,269
Total Recommended Institutions	1,66,130	2,11,308	73,96,560	1,28,88,044
Total Unrecognised Institutions	16,322	16,647	4,22,165	50,15,380
Grand Total	1,82,452	2,27,955	78,18,725	1,33,89,574

**Table - 4: Progress of Secondary Education (From 1881 to 1937)**

Year	No. of Secondary Schools	No. of Students in Secondary Schools
1881 - 82	3,916	2,14,077
1901 - 02	5,123	5,90,129
1921 - 22	7,530	11,06,863
1936 - 37	13,056	22,87,872

The main period of decline in the educational sphere of the country was between 1940-45 after which an upward trend is observed. One noteworthy improvement during this period is the constitution of All India Technical Education Committee on the recommendation of which Polytechnique Colleges were established in the metropolies of India. Yet Engineering and Technical Colleges in the country could not make much head way during the decade. Such colleges being nine in 1937 A.D. could not reach upto fifteen in 1947 A.D. Likewise Engineering and Technical schools also showed a very tardy progress. On the other hand, no such effort was made to change the curriculum which was much needed in the field of science and mathematics education. During the war period many new technologies grew up which demanded various types of mathematics around the globe. In fact,

with the progress of science new technologies came up and new products spread in the western countries as well as in some of the Eastern Countries like Japan. There is a spiral growth from science to technology and from technology to product and from product to science again. The changing pattern of the society as regards to the science and technological advancement very much depends upon this spiral structure. And it is a fact that to link science and technology to yield new products of sophisticated order, mathematics is the key. . . . When product demands new technologies, technology demands new scientific theory, and it is fed with the help of mathematics only. With this consideration it is seen that very little was done or practically nothing was done to improve the mathematics education as a whole during the pre-independent India except the introduction of some new branches of study at the postgraduate level in a few Universities.

## 1.2. DEVELOPMENT OF MATHEMATICS EDUCATION IN INDIA: POST INDEPENDENT STAGE

### 1.2.01. A New Wave

From the above discussion it is clear that although western education has made a long way through our educational system the condition of science and

mathematics education was really deplorable during pre-independent period, and very little attention was paid to spread for scientific and technical education. In the post independence era, Pandit Jawaharlal Nehru after assuming the Office of the Prime Minister, was the first to visualise the importance of scientific and technical education in the industrial growth of the country. Because of his earnest feeling and firm conviction the revolutionary thinking in science and technology was inducted. As a result, the importance of mathematics education was bound to be focused in India. Pandit Nehru said:

"Mathematics should be visualised as the vehicle to train a child to think reason, analyse and to articulate logically. apart from being a specific subject it should be treated as a concomitant to any subject involving analysis and reasoning."18

Accordingly, the 'revolution' started with the post-graduate system on the experimental basis. This experiment proved to be successful and the new ideas of improvement of mathematics and science education was welcome by the teachers of the Universities. The overall impact of this revolution that fell upon the teachers was that they went through the new courses and within a very short period a good number of them happened to be up-to-date. That was

the most noteworthy result of the fast-spreading ideas of revolution.<sup>19</sup>

It then took about a decade to role down the impact of revolution from Universities to the lower levels. It was strongly felt that India's secondary school mathematics had been completely static for a pretty long time. The system failed to induct the spirit of mathematics as no change have been made for many years. Also various traditional outlook stood on the way of revolutionary changes. Books written many years ago were still being used in the schools.

On the other hand, the impact of tremendous explosion of knowledge reached upto the secondary level by then in the other parts of the globe.

In USA, the National Science Foundation has contributed more than four million dollars to School Mathematics Study Group (SMSG) for the development of sample textbooks. A joint team consisting of a good number of mathematics teachers wrote these books for secondary stage on experimental basis. The books were tried with about 100,000 students. Books were then revised and rewritten in the light of the survey work on the reaction of students and teachers and then were published in the

commercial scale.<sup>20</sup> SMSG was soon followed by some other groups formed in the University of Illinois, University of Maryland, University of Southern Illinois, Ball State Teachers College, Boston College and few others. Besides these, number of Summer Institutes were organized where about thirty thousand school teachers were trained in 'new' mathematics. These teachers were given compensation for the loss of vacation and this scheme alone demanded a sum of more than fifty crores of rupees. Various private organisations along with Government agencies spent a considerable sum for development of mathematics education in different direction. For example, in preparing better textbooks in organising Summer Schools, and so on. Journals, Periodicals, Lecture-notes etc. were published for the benefit of teachers and the students. Such efforts were observed not only in U.S.A. but throughout in Europe.

In U.K., School Mathematics Project (SMP) was formed to reorient school mathematics. Two other groups, namely the Midland Mathematics Project (MMP) and Soptire Project worked parallely to publish a good number of new textbooks on school mathematics. By 1961, the organisation for European Economic Cooperation in collaboration with

Mathematical Association of America held several seminars on survey work and published their report "New Thinking in School Mathematics". The Report reveals the condition of Mathematics teaching in the West European countries. It also suggested the reforms necessary for the improvement. Countries like Belgium, Sweden, Norway, Denmark, France and Italy started similar programmes to improve school mathematics. Famous mathematicians of these countries took keen interest in leading the movement and in writing better textbooks for schools.

Attempts in this direction was observed not only in Europe but in Africa also. This can be judged from the fact that the African Education Programme of Educational Service has published a series of books called "The Entebbe Mathematics Series" which reflects a completely modern spirit.<sup>21</sup> All these developmental activities in Mathematics education started assuming an international character in late sixties and as a result the first International Congress on Mathematics education came into existence.<sup>22</sup>

In India also efforts were being made for such revolution. One of them came out successfully at about 1963 when the first Summer Institute of Mathematics was organized at Delhi. It was sponsored by NCERT and U.G.C. in collaboration with the teachers of Columbia University.

This was an institute for discussion of various aspects of the revolution such as reformation that may be brought in curricula, textbooks, teaching methods etc. and the teachers from various educational institutes took part in it. This was an experiment, first of its kind in India that brought tremendous success. Encouraged by this enthusiastic response, the authorities increased the number of Summer Institutes to four in 1964, to sixteen in 1965, and to twelve in 1966. About 1309 school teachers were trained in new secondary mathematics in these 33 Summer Institutes. Now-a-days such Summer Institutes of mathematics have become a regular feature of every year throughout the country.

Additionally, number of conferences were held on mathematics education by Education Department, NCERT and UGC. Various schemes and projects were taken up on the basis of the reports of such conferences. In 1963, NCERT took up a scheme for identifying scientific talent at the end of secondary stages. The tools used for selecting such talents were scientific aptitude test and an interview. This scheme was started in Delhi which was extended all over the country by 1964. Till 1965 each scholarship was awarded for a period of three years but afterwards the period is increased to nine years. Previously it was

only for science talents but now-a-days ten special scholarships awarded to the talented students in mathematics separately. Of late, the Olympiad in mathematics are conducted all throughout the country. Thus attempts are being made to improve mathematics education.

After a decade from starting the revolution in mathematics education, remarkable development in the field of mathematics in India could be observed. These may be summarised as follows:

1. A number of branches of modern mathematics have been introduced in the mathematics curriculum right from school stage. Though many branches are still unrepresented and there are only a few scholars who have come somewhere near the world standard, yet there has been a great upsurge in this direction and enthusiasm has been noticed among the youngmen to take up new branches.
2. In the world directory of mathematician, 107 mathematicians from India were listed against a total of about 5000 mathematicians in the whole world in 1966.
3. The average number of the Ph.D's in Mathematics from all Indian Universities and Institutes were 12 per year during 1965-66.

4. There are about 40 Universities and Institutes offering post-graduate courses in Mathematics, though courses are not up-to-date and the total enrollment of the students are above three thousand in these courses.
5. The number of the journals (on mathematics) published are about six to ten. Though this number is negligible compared to the mathematics journals published throughout the world, the overall development in mathematics in our country cannot be considered as insignificant.<sup>23</sup>

Attempts were still being made to accelerate the progress. In 1966, to make a detailed study on the basic problems faced by mathematical education in India, a committee was formed under Vikram Sarabhai Community Centre,<sup>24</sup> the aim of which was to explore the possibility of producing better curricula, better textbooks and also to prepare the teacher community for the successful implementation of projects made for High Schools launched by the Community from 1969-70 to 1975-76. These projects showed some success.

By then, the Central Advisory Board of Government of India decided to adopt a policy for a uniform pattern of

education, which is to be taken up by the whole country and on the recommendation of Education Commission 1966, the 10 + 2 + 3 pattern of undergraduate education has been launched. Also all the States were instructed to revise the curriculum, particularly the School curricula, on the guideline of Commission's recommendation. By 1978-79, almost all the States of the country introduced the new syllabus as per the recommendation of Kothari Commission.<sup>25</sup>

#### 1.2.02. Post Kothari Commission Development

India was proceeding ahead through no wide path of development. Various efforts in this direction was successful, some of which are stated as follows:

Many State Government have revised their Syllabi Textbooks in regional languages are produced accordingly. The Council for Indian School Certificate Examination has introduced New Mathematics as an alternative.

A school mathematics project was started at Kanpur and Meerut for training school teachers in new ideas and for training the parents of the students also. A number of books were published for this project. Central Board of Secondary Education also revised its syllabus significantly according to the 10 + 2 pattern.

UGC and NCERT also play an important role in the development of mathematics. UGC appointed a Review

Committee on Mathematics in August 1959 A.D., the report of which was published in 1961.<sup>26</sup> Consequently, in 1964 A.D., a Mathematics Reform Committee was formed by UGC and its report was published in 1966 A.D. Government of India appointed a panel of senior mathematicians in 1961 A.D. to write a series of new textbooks. This panel was replaced by Editorial Board which produced few books for schools and teacher's guide, which were published by NCERT. Moreover, NCERT published some more textbooks and teachers guide with the assistance of UNESCO.

A large number of summer schools for training mathematics teachers for schools and colleges were conducted frequently. Here, attempts were being made to expose these teachers to modern ideas so that they can create a climate for change in mathematics education. These Summer Schools have been conducted by UGC, NCERT, State Government and private agencies. Summer Schools were held not only for the teachers but also for the students and these schools have done a great deal to encourage the bright students.

Besides these, a number of conferences have been held from time to time. Various national and state level associations for improvement of mathematics education was formed. Many of them are publishing various mathematical

journals regularly, both in English and in Regional Languages. Few important activities of these associations are given below:

1. Association of Mathematics Teachers of India has been holding regular annual conferences and has published its journal 'The Mathematics Teachers' regularly.
2. The Delhi Association of Mathematics Teachers held mathematical competition for the school students of Delhi and publishes a 'Newsletter'.
3. Andhra Pradesh Association of Mathematics teachers formed in 1973 has been publishing 'Newsletter'.
4. Orissa Mathematical Society, formed in 1971 A.D., have been holding conferences on mathematics regularly.
5. The Association of Improvement of Mathematics Teaching in India, also conducted a number of conferences and training programmes for the review of West Bengal curriculum. In this context, we can name of another association, The Calcutta Mathematical Society.
6. Other states like Assam, Punjab, Bihar, Haryana, Himachal Pradesh etc. has also shown their sincere efforts in improving mathematics education. Some noteworthy magazines on mathematics education are

'The Mathematics Education', 'Bulletin of Mathematical Association of India' and 'The Mathematics Seminar'. Many are published in regional languages also.

At the undergraduate level including plus two state, the most important programmes are launched by the College Science Improvement Programme (COSIP). Under this, many Universities of the country has come up with various activities like publishing instructional material which are prepared by College teachers after mutual discussion. Also a series of books on Mathematics through games, objective type question banks etc. are published. A good number of Colleges under COSIP have produced standard materials on mathematics education. These Colleges received grants from UGC for improving undergraduate mathematics teaching and to develop teaching aids, provide tutorials, arranging exhibitions, inviting guest lecture and also to supply cyclostyled notes to the students.<sup>27</sup>

Thus, considering all points of view we can conclude that although the contribution of Indian mathematics to the world mathematics is quite insignificant, yet the overall development of Indian mathematics is not negligible. India is definitely among the first ten mathematically developed countries of the world, also much ahead of all other Asian and African countries except Japan.

### 1.3. MATHEMATICS EDUCATION IN MEGHALAYA

The history of Mathematics education in Meghalaya cannot be isolated from the history of mathematics education in the country as a whole. It is true that the present educational system originally began on an altogether different objective which was aimed at, in the beginning, to train only the administrative manpower to meet the requirements of the Government.<sup>28</sup> However, eventually it also became necessary to start science education right from the school to keep pace with major scientific discoveries of the time. Meghalaya, rather, the then Assam, was also enveloped by this pattern of education. After independence although, India leaped into science and technology, rather in a big way, it failed to review the need of developing science education in general and mathematics education in particular. In accordance with the development of the Western developed countries, the north east region as a whole, being strategic in more than one way, had been set aside in the field of education. As a result, the curriculum development, the teaching methodologies, and also the development of the text books and other teaching aids could not gain due importance. The Universities set up in the region has confined themselves to degree and post-graduate levels without involving any

mechanism to link its system with that of school education.

Meghalaya, happened to be born in 1972 inheriting every system including the educational set up from Assam. It is true that certain changes were brought in prior to the creation of Meghalaya in the then Assam. But due to various factors discussed below, the districts of the hill areas could not be enveloped successfully by these changes. In a survey report made by Dr. B.K. Dev Sarma,<sup>29</sup> it is revealed that there are four major factors confronting the growth of mathematics education (and so science education in general). They can be categorised as:

1. Social Factor
2. Individual Factor
3. Institutional Factor, and
4. Political Factor.

The detailed discussion of these factors creating backwardness in mathematics education as a whole is dealt with in Chapter - II. However, it is observed that these factors in general have affected the mathematics teaching at plus two level to a great extent rather, giving a dead blow to it. As is seen Primary Education in Meghalaya

is mostly a matter of District Council Administration. After which high school education is managed by Secondary Education. Finally, plus two stage still known as the Pre-University is still under the cover of colleges tied with the University. In principle, plus two stage has been separated out almost all throughout the country and put under a council known as Higher Secondary Council. Here, in Meghalaya perhaps due to the scattered density of population with its low input, it has not been possible to set up separately a Higher Secondary Council. Initially there was a single higher secondary school during seventies and the Academic affairs of this school was managed by Meghalaya Board of Secondary Education. Eventually, this is also abolished and at present all these students in plus two stage are going through the collegiate education although according to the UGC guidelines they do not fall under it. The North-Eastern Hill University has, however, set up a separate council for this stage within the University system.

Under the present system of management it appears that the education system in Meghalaya has failed to be of continuous nature. As a result, it has not been possible to frame a unified education policy to bring together the children of all the districts in the

State' under a suitable pattern. The mathematics as a subject of study was not compulsory beyond middle school stage upto 1983.<sup>30</sup> It is really a very short period to cover up a congenial atmosphere for mathematics education after it has been made compulsory for the first ten years of school. In numerical terms it can be stated that at present approximately 1,85,696 primary and 24,000 secondary pupils are target of mathematics teaching. But surprisingly enough this big number of people, getting mathematics teaching upto the HSLC examinations reduces to 1,500 (approximately) only at plus two level. This shows the national education system prescribed, which provide a common content (curriculum, of course, with wide variation of Meghalaya, has failed to yeild a desired level in mathematics. The result of the HSLC examination where a pass in mathematics is essential for promotion, shows the low yield beyond expectation.<sup>31</sup> How much this reduction is in due to failure in mathematics is discussed in Chapter - II.

Another point noted in our investigation is that, mathematics education at plus two stage is still not linked up adequately with that of the high school stage, the detailed discussion of which is presented in Chapters II & III of this thesis. However, I would like to emphasise

on the fact that due to the old pattern of mathematics curriculum followed in the same way for long years without conducting the modern changes has caused a great hindrance to pursue plus two mathematics in the proper spirit. It has been observed that the mathematics curricula have undergone various changes for two three times whereas the mathematics curricula at high school stage have remained static all throughout except some changes brought into the teaching methodologies. The SCERT, Meghalaya came up in the year 1976 only. Since its inception the Council have tried in various ways to improve the mathematics standard at the high school stages. The Council took up various projects to improve the mathematics teaching at the primary as well as high school states.<sup>32</sup> In order to help the high school teachers, the SCERT also published a series of guide books on teaching mathematics<sup>33</sup> which have thrown some light on improving mathematics teaching. But unless the recent developments and relevances of mathematics are inducted in the school curriculum, the changes brought in at the plus two stages in mathematics teaching becomes almost futile. Meghalaya is mostly suffering from this defect as regards to mathematics education at the plus two stage.

#### 1.4. IMPORTANCE OF MATHEMATICS

Mathematics has always been playing the most important role in the growth of civilization since from the very beginning of it. Its impact on the civilized world may not be obvious always, but its indirect impact cannot be denied. Today, as the knowledge of mathematics is expanding unboundedly with time more and more we are marching ahead towards progress.<sup>34</sup>

It is very clear that mathematics forms the foundation of technical and scientific growth. Human civilization witnessed the tremendous exploration of scientific knowledge since ages which gave birth to various scientific inventions that has become indispensable in every walk of life. The basic principles of all such inventions are mathematical theories. And many of these inventions are due to the scientists who were basically mathematician. James Watt, the inventor of Steam Engine, was a famous mathematician. In fact, no invention would have been possible without mathematics. In the other fields of science also, mathematics is being used continually.<sup>35</sup> Intensive research work has been and still being carried out which are very much dependable on mathematics for the huge computational works. So far as life science is concerned, mathematics

has found its place in this branch also. Because it is of immense help in the process of analysing the series of various observations. Moreover, study of biology depends upon two of its branches viz. biophysics and biochemistry, which have attained a rank almost equal to that of independent sciences. Knowledge of Mathematics is required to understand these branches, as a result, biomathematics is growing as an important field of the study of life sciences.<sup>36</sup> Today, man is capable of mastering over the nature due to this scientific knowledge. The rapid growth of scientific knowledge has helped human race to reach in the age of compute, age of space. Undoubtedly mathematics was the vehicle for this journey of mankind. Today space shuttle are being launched by many countries where a great deal of computational technology is required. So again mathematics is the first step to the space science. It may be mentioned here that the first Indian space shuttles, 'Aryabhatta' and 'Bhaskara' was named after the great Indian mathematicians of vedic age. In all ages mathematics is regarded as the basis of all sciences. In the words of the famous philosopher Kant, "A natural science is a science only in so far as it is mathematical". And famous scientist Helmholtz expressed his views in the following words: "The final aim of each natural science is to resolve itself into mathematics."<sup>37</sup>

Not only on Science, but mathematics is the necessary part of the various branches of Social Sciences also. Study of Economics is not possible without mathematics. Educationists even recognised the relation of mathematics with abstract subjects like Psychology and Philosophy. Without going into much philosophy also, the above fact become clear when we consider the great deal of contribution of famous mathematicians like Pascal, Descartes and Leibnitz to Philosophy.<sup>38</sup>

Thus practical values of mathematics education are recognised all over the world. it is not possible to wipe off mathematics from modern world, which will mean the end of the civilization. In all major and minor activities of life of all persons of all categories of society, mathematical considerations occupy the upper most place in a human mind. Napoleon truly remarked that "The progress and the improvement of mathematics are linked to the prosperity of the state."

Besides , these material values of Mathematics, this subject's contribution to the total personality of a human character, cannot be ignored. Learning of mathematics helps to learn to think logically and rationally which is very important. According to Lock, "Mathematics is a way to settle in the mind a habit of reasoning".

The thorough knowledge of mathematics acts in human mind as a mean for description, as a mean for systemization, as a mean for verifying the truth. The most important role of mathematics is its role of deductive reasoning.<sup>39</sup> Due to its very nature it possesses this feature which develops the habit of reasoning and logical thinking power in the minds of learner. Another feature of this subject is that one can easily follow a gradation going from simple to complex while learning mathematics. The procedure on practice helps the learner to advance by degrees to harder and harder portions, not only in mathematics but in real life situation also. Thus mathematics helps a learner to grow as a rational, hard working, systematic citizen, having a broad outlook.<sup>40</sup>

Today, importance of mathematics in the evolution of human civilization is recognised all over the world. Government of India made a significant step through National Education Policy 1986, where more emphasize was given in the field of science, and mathematics was incorporated as compulsory subjects for both boys and girls upto the secondary level.<sup>41</sup>

#### 1.5. MATHEMATICS IN THE OTHER PARTS OF THE GLOBE

Mathematics education has obtained important place in the educational system of all the developed countries

which can be measured by their technical achievement. In the developing countries also continuous attention is being paid to the improvement of mathematics education.

#### 1.5.01. U.S.A.

U.S.A. being the most developed country in the world, also claims one of the top positions in the world of mathematics. Intensive drive has been made in the states for improving mathematics education at various level. This can be visualised from the following facts:

- (i) In U.S.A. and Canada, the number of Ph.D's in Mathematics during the entire period upto 1955 was 3,796. From 1956 to 1962, an additional 2,056 degrees were awarded. Afterwards, the number was nearly doubled in the next twelve years.
- (ii) The expenditure on scientific and technological research was about 90,000 crores of rupees per year in the early sixties. This amount was doubled in a span of time less than a decade.
- (iii) The number of books and research journals are also increasing at a very fast rate. Not only in the higher level, but a handsome amount is spent to improve school mathematics also, which involve efforts of hundred of University professors.

(iv) , A large number of teachers are trained in Summer Institutes of period ranging from four to eight weeks.

(v) Various projects have been taken up to take necessary action to improve mathematics education.

Among them few important are:

#### **1. School Mathematics Study Group (SMSG)**

This group was formed in the Stanford University, California in 1958. The main objective of this group is to carry out research on development in the teaching of school mathematics. The most important effort made by SMSG have been the preparation of textual material designed to illustrate the curriculum that is to be reformed according to the needs of American Society and with this the preparation of material for the teachers that would help them to teach such a curriculum. It is the effort of this group for which an integrated, sequential mathematics curriculum for secondary and higher secondary level came into existence. A second major activity of this group is the contribution of the National Longitudinal Study of Mathematics Abilities in which students of secondary stages are being followed to determine the effects on conventional, SMSG, and other new course sequence on performance in mathematics.<sup>43</sup>

## 2. University of Illinois Committee on School Mathematics (UICSM)

This Committee was formed in 1958 to investigate the content and teaching of pre-college mathematics in the higher secondary state.<sup>44</sup> Firstly, with the financial support of Carnegie Corporation of New York, this committee developed variety of instructional material. Afterwards with the support of NSF (National Science Foundation) UICSM carried out this work more effectively to which new scheme of the programme, namely fifty film series for training the teachers has been added. It also prepared a special course in different branches of mathematics for under-achievers in mathematics, a preliminary version of which was tried in the public schools of the town. A revised version of this course was tried in several other schools afterwards.

## 3. Cambridge Conference on School Mathematics

The aim of this project,<sup>45</sup> which was formed in 1963, have been to encourage intensive study and discussion among mathematicians and scientists, relating not only to the present content, structure, and sequence of mathematics curricula, but also in determination of alternative long-range goals in teaching of mathematics. To attain the goal, this project has conducted a number of conferences on various aspects of mathematics

education which has established better communication between the various individuals and groups concerned with educational reforms in mathematics.

#### **4. Experimental Teaching of Mathematics in the Elementary Schools**

Formed in 1959 this project aimed to develop a modern mathematics curriculum for elementary and middle school. The main activity of this project is the development of a computer based laboratory for teaching of elementary school mathematics.<sup>46</sup>

#### **5. Boston College Mathematics Institute**

The major object of this Institute is to assist the teachers of mathematics by offering special courses for the teachers and by preparing contemporary mathematics text for both the teachers and the students.

Besides these, there are numerous other agencies like "Survey of Recent East European Literature in School and College Mathematics", "the University of the State of New York Programme" and many others. These agencies are developing their own programmes to improve mathematics education. As a result, a number of excellent books on mathematics were produced which proved to be very useful both for teachers and students. Not only in publishing books and teachers' guide, but many signifi-

cant efforts were made and is being made for the betterment of mathematics teaching.

#### 1.5.02. **United Kingdom**

A considerable thinking was done in U.K. also. The mathematics educators have evolved different programmes and methods which are consistent with their national goal and socio-economic conditions. The important feature of the mathematics education of U.K. is that, also called traditional mathematics has not merged into new mathematics, instead a healthy balance and integration between these two is still being maintained there. In these countries also, various projects have been formed in order to develop mathematics teaching. The biggest of U.K. projects is the School Mathematics Project which was formed in 1960. The major aim of this project is to modernise the content and teaching of mathematics in the secondary level. Among the other activities of this project, the followings can be mentioned:

- (a) Due to this project, a number of good books were published for advanced mathematics which were accompanied by teachers' guide. These teachers' guide is also being published simultaneously along with each of the books.
- (b) SMP organises teacher-training conferences which are open to overseas candidates also.

Among other projects of U.K., there are Midland Mathematics Project, Nuffield Mathematics Project, Psychology and Mathematics Project, University College Swansea Project, Contemporary School Mathematics etc.<sup>47</sup> All these projects are contributing in country's mathematics education by their own method as for example, by preparing textbooks, teachers' guide, producing films on mathematics and so on. Various groups also evolved a draft scheme of new topics in mathematics.

### 1.5.03. Some Other Countries

The other countries are also not lagging behind so far as development of mathematics education is concerned. Movement for reformation in mathematics education in France was led by eminent mathematicians. In Belgium also such effort in reforming was made. The movement there, was led by Professor Papys. Teachers Training Courses were organised by 'Belgium Centre for Mathematics Education', where a number of teachers has been trained. In Germany, 'the UNESCO Institute for Education', Hamburg has published "Mathematics in Primary Education" which deals with the studies of learning mathematics by young children. Nordic countries, namely Sweden, Norway, Denmark jointly launched Combined Mathematics Project. USSR, one of the most developed countries of the world, is clearly

not lagging behind in mathematics education. This country, on depending to their social needs, has more tilted towards application. A large number of research fellow are working on the better designing and improvement of computers. Moreover a significant number of good textbooks are also prepared regularly which serve the need of the whole world.<sup>48</sup>

#### 1.5.04. Asia and Africa

On the other hand, the condition of mathematics education in Asian and African countries, which are termed as developing countries are not as good as the European countries with an exception of Japan. But sincere efforts are observed all over the world to bring up the standard of mathematics education. In many of these countries the mathematics project have been heavily financed and aided by USAID. In Kenya SMP books and in Nigeria MME ideas have been tried. Some Commonwealth Countries of Africa also shown interest in SMP books. So special editions of these books, adopted to African conditions, was made available to them. In Ghana, the mathematics staff of five schools have brought out textbooks with the support of Nuffield foundation. The most successful efforts in Africa was due to African Education Programme of Educational Service incorporated in U.S.A.,

which has held Entebbe mathematics conferences where a complete set of books have been published by this agency.<sup>49</sup>

In Asian countries attempts are being made continuously to improve the educative system for mathematics. In Iran the development of the country necessitates the development in mathematics, for which various steps have been adopted. 'Iranian Organization for Textbook' was established to have better textbooks prepared for different level, Organization for Educational Technology was formed to produce audio visual aids and so on. Moreover, because of the shortage of mathematics teachers, an Institute of Mathematics was established in 1966, which offer intensive training preparing lectures for teachers training college. To deal with various problems of mathematics education, 'Iranian Mathematical Society' was formed in early seventies. This society has contributed significantly towards the improvement of mathematics educations.<sup>50</sup>

Serious endeavours have been made to improve mathematics teaching in Iraq and other Arab countries in co-operation with the UNESCO, which adopted a project named "The UNESCO Project of Improving Teaching of Mathematics in the Arab Countries". Besides, in Iraq, a Department of Mathematics was formed which regularly procures

publications concerning the application of modern mathematics in other countries of the world. Also the specialists in mathematics and mathematics education are encouraged to take part in conferences, dealing with problems of mathematics education, held by International Mathematical Organizations.<sup>51</sup>

Efforts were made in improving mathematics teaching in South Asian Countries also. As a system of mathematics education a regional centre called Regional Centre for Education in Science and Mathematics (RECSAM) was formed in Malaysia, whose primary object is to work on the improvement of Science and Mathematics teaching by providing training, research and development and special services for participants from South East Asian Countries.<sup>52</sup>

In Sri Lanka, 'A Mathematical Development Project' was launched. There are other organizations also those are concerned with development of mathematics teaching. Two of them are 'Curriculum Development Centre' and the 'Department of Examination'. The latter one deals with evaluation.

In Bangladesh, UNICEF has taken significant step to improve the primary level curriculum for mathematics. At the same time it also prepared teachers' guide for primary level. Attempts are being made at the other level also.<sup>53</sup>

To visualise the mathematical development all over the world, a group, named International Clearing House on Science and Mathematics Curricular Development, publishes annual reports of individual projects all over the world. This acts as a mirror for development and may prove useful to the research workers of all over the world.

#### 1.6. MATHEMATICS EDUCATION VIS-A-VIS NEW EDUCATION POLICY

The National Policy of Education 1986, emphasized the importance of teaching mathematics as a part of general education. The country-wide situation of mathematics education has failed to reach the expected standard. The present state of mathematics teaching is far from satisfactory in majority of the schools. The rate of failure in mathematics is also much higher compared to that of in other subjects. When this is the condition of mathematics education, on the other hand, the demand of mathematically skilled persons is growing at a very fast rate, rather exponentially. Our society is moving into a technological era for which, our country needs large number trained manpower with sound mathematics base. This fact was also stressed in Kothari Commission Report.<sup>54</sup> Prior to it when the revolutionary wave of new mathematics broke out around the world, some steps were taken up in this direction in our country also. Since then, mathematics curriculum

upto +2 level has undergone various changes from time to time. About the success of modern mathematics nothing can be said definitely, but there is no doubt that qualitative betterment of mathematics education is the need of the day.<sup>55</sup>

Keeping all these aspects in view the National Education Policy stresses on mathematics teaching<sup>56</sup> where the corrective measures are to be adopted. The NCERT and SCERT's have been entrusted to initiate several steps to improve mathematics education at the national level as well as the state level. Organisation of seminars, workshops, publishing useful materials, conducting mathematics olympiad etc. are some of their various activities. In spite of all these efforts, it can be said that the success of mathematics teaching depends ultimately on the classroom teacher, and it is he, who can make learning of mathematics more enjoyable in his own way. NEP has proposed to work with this consideration and has prepared a module for teachers with a purpose of making them aware of advantages and drawbacks of present teaching system. This module which will help the teacher to understand the implication of NPE 1986, for, proper mathematics education will enable him also to critically understand the objectives of teaching

mathematics. This will help him to ascertain the reasons for low achievement level of a majority of pupils in mathematics in the country. And then it will direct him to take appropriate remedial measures like (i) to identify common mistakes made by the pupils, (ii) to develop activity oriented lesson plan, (iii) to plan a mathematical laboratory in the institution, and so on. Since it is not possible to prescribe remedial measures for everyone in general, NEP emphasizes on the discovery of the own remedial measures of the teachers.<sup>57</sup>

The Policy describes the following as the objectives of learning mathematics specially at the secondary level:<sup>58</sup>

1. To acquire knowledge and understanding of the terms, concepts, principles, processes, symbols and mastery of computational and fundamental processes that are required in daily life and for higher learning in mathematics.
2. To develop skills of drawing, measuring, estimating and demonstrating.
3. To learn to apply mathematical knowledge and skills to solve problems that occurred in daily life as well as problems related to higher learning in mathematics or allied areas.

4. To develop the ability to think, reason, analyse and articulates logically.
5. To learn to appreciate the proper and beauty of Mathematics.
6. To show an interest in mathematics by participation in mathematical competitions and engaging in its learning.
7. To develop a reverence and respect towards great mathematicians for their contributions to the field of mathematical knowledge.
8. To develop necessary skills to work with modern technological devices such as calculators, computers etc.

It appears that NEP has stressed two very significant aspects. They are on to act as guideline for the teachers as follows:

(i) "To promote equality, it will be necessary to provide for equal opportunity to all not only in access but also in the conditions for success."

(ii) "Minimum level of learning will be laid down for each stage of education."<sup>59</sup>

In the process of curriculum development at any stage, the foremost task is to identify the portion that

constitute essential mathematics. They are the topics or the concepts which are of functional use and all further studies are based on them. Such learning points of essential mathematics should be acquired by all at mastery level. These learning points which are to be acquired at mastery level can be taken as minimum level of learning. This minimum level of learning is relevant and valid not only in primary and middle school level but also in secondary stage. The expected minimum level of learning should be indicated in the curriculum. But that is not sufficient, and NEP welcomes the teachers to come up with their own views on minimum level.

NEP emphasize that mathematics is the discovery of human minds and teaching of mathematics should be guided to discovery. That means, teaching of this subject should not be only a descriptive process. Teaching of mathematics is to stimulate students thinking and reasoning power, and for this purpose teaching should be activity oriented. Mathematics should be learnt by doing. To carry out this successfully, NEP recommends organisation of mathematical laboratory, workroom in the institutions.

Lastly, NEP stresses on the education for all the students irrespective of caste, creed, location or sex.<sup>60</sup>

It emphasizes that access of education of comparable quality with sufficient condition for success is to be provided to all students. Mathematics education of comparable quality is also to be achieved by all. With proper implementation of NEP, the nation will have more and more children who are first generation learners from the disadvantaged and deprived section of society.<sup>61</sup>

As the situation is, mathematics is found to be very difficult by a majority of students. So some specific steps should be taken at institutional level and individual teachers level so that mathematics education of comparable quality can be imparted to all. To achieved this NEP suggests that a multi media approach for curriculum transaction is required. Educational technology should be extensively used. Mathematics education recommends that in place of a single textbook various instructional packages can be developed which may consist of supplementary problem book containing additional drill material and some challenging problems, enrichment material, model, charts, films recreational mathematics etc.

From the above discussion it is clear that the new Education Policy has identified the strength and weakness of present system of mathematics education and clearly enunciates the direction for reshaping the system particu-

larly at the secondary and senior secondary level.  
The success of mathematics education depends on full  
implementation of NEP.<sup>62</sup>

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CHAPTER - II

PRESENT STATUS OF + 2 MATHEMATICS IN THE STATE

## PRESENT STATUS OF + 2 MATHEMATICS IN THE STATE

2.01. Mathematics is said to be a man-made subject. Since ages, men were motivated towards science and mathematics because of their social needs. Today, mathematics and science function as the foundation of the modern economic system. It is a fact that the social and economic development of a country requires a climate of widespread and popular acceptance of science and technology. But somehow or other the base of mathematics and science education in our country continues to be weak notwithstanding the growth and spread of education in the post independence period. The fast expansion of science and technological education could not succeed in providing adequate support in critical discipline like mathematics.

North Eastern region is also not an exception to this general national situation. In addition to this, the educational system of the region suffers certain other handicaps notwithstanding the overall higher rates of literacy achieved. Various aspects of this problem are: (i) lack of adequately trained personnel, (ii) lack of basic motivation, (iii) limitation of traditional course content and examination requirement, (iv) political and social deterrents to innovations.<sup>1</sup> Impact of all these made the whole north eastern region exceptionally backward in science and mathematics education.

contributing a highest rate in mathematical illiteracy. Because of the weak foundation in basic sciences the region is not in a position to make comparable contribution to its manpower resources and thus suffering in overall development notwithstanding of its natural resources.

Remembering the profound effect of science in modern world, the New Education Policy has strongly recommended the strengthening of mathematics and science education so as to develop incoming generations with a sense of enquiry, creativity, courage to question, ability to think, reason analysis and articulate logically. The prime object of mathematics education is to develop in man the power of logical thinking and reasoning. Education has always been necessary to help man adjust to his surroundings which undergoes change from time to time. Today, whole mankind live in a world of accelerated change produced to a large extent, by science and its application in technology. Here all men are affected by and must have an understanding of the impact of science on human affairs. A grounding in the basic principle of science and mathematics can help men to adjust to the change of modern life. Proper mathematics education develops in a student a scientific and realistic attitude towards life.<sup>2</sup>

Mathematics education is also necessary to prepare a student for elementary, as well as higher

education in science, technology, economics, psychology and many other subjects. Ignorance in mathematics will cause a great handicap in study of these subjects.

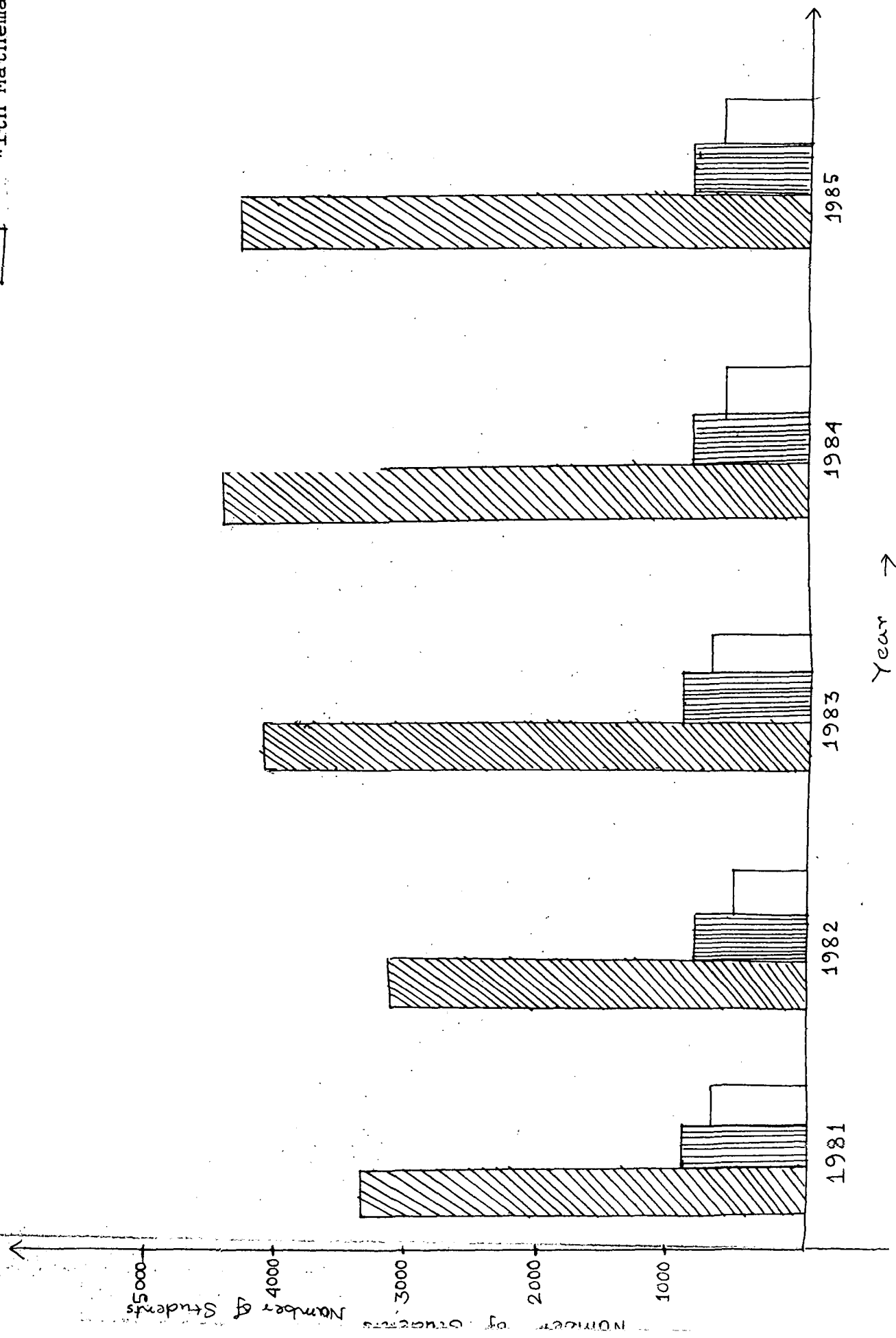
• In north eastern region, lack of technical manpower is strongly felt in recent years, so as to assess and utilise the rich natural resources of the region. An important reason for this is that the mathematics and science education over here is not adequate.<sup>3</sup> As mentioned earlier, the mathematics education in the north eastern region particularly in the hill state of Meghalaya, undergoes various problems at different stages of educational system. Like the other parts of the country, mathematics is a compulsory subject upto Class X, that is, secondary level in Meghalaya. But the situation becomes critical at higher secondary or plus two level where mathematics is treated as an optional subject. Even in the science stream it is not compulsory. The number of the students in this subject is rather low than the number expected.

An analytic look over the situation reveals the fact that the mathematics education at plus two level in the state suffers from various difficulties. The main problems it has to face are as follows:

FIGURE

Figure Showing The Low Intake Of Science & Mathematics Among Plus Two Students Of Meghalaya.

- Students Appearing P.U. Examination.
- Students Appearing P.U. Science Examination.
- Students Appearing With Mathematics.



1. The Defective teaching system.
2. Unmotivated students.
3. Defective admission policy.
4. Outmoded curriculum.
5. The problem of textbook.
6. Defective examination system, and
7. Backwardness of area as a whole.

#### **2.1.01. Defective Teaching System**

The stability and success of teaching learning system is very much dependent on teachers. Undoubtedly teachers form the most important part of the system. The two equally important aspect of this profession that helps a teacher to carry out his duty successfully are through knowledge over the subject and effective technique. A teacher's educational qualification is related to knowledge and professional training helps him to find out and follow effective teaching method. In this state, the defect lies in these aspects, namely inadequacy in preparation and training of the teachers. In college level, the teachers are selected on the basis of their performance

in M.Sc. But the problem is that, these teachers have had neither a good training in the M.Sc. level nor have they been exposed to good mathematics. So when they come to teach, insufficient and inadequately prepared, they might become able to put the material across, but not the spirit and excitement of modern mathematics.<sup>4</sup> At any level, a teacher cannot teach effectively unless his knowledge and understanding go well beyond the scope of that which he is expected to teach.

Another important reason for poor quality of teacher is the lack of adequate social security and retirement benefits in the pay-structure currently prevailing. The poor salaries, raising price, inequitous benefits for equally qualified persons in the other walks of life brings down the social status of the teachers. As a result, the teacher gradually loses interest either in teaching or in self improvement.<sup>5</sup> This is also a reason why the brighter students are not being attracted towards this profession. Unless the good students choose their career as teachers, inadequacy of good teachers will continue over the state. Successful teaching of mathematics can only be carried out through dedicated teachers who have genuine love for the subject.

No curricular innovations in mathematics can succeed unless there are competent cadres of well-trained

teaching personnel. This necessitates training of two types, namely (i) preservice training for the new entrants to this profession, and (ii) inservice training for updating the existing teachers.

It is universally agreed that only teachers with a strong academic background would be able to instill enthusiasm and curiosity among students.<sup>6</sup> Thus, to teach in plus two level a good master's degree on the subject is the first and foremost requirement. The study of M.Sc. course, which is of two years duration provides a person with knowledge over the subject. But, though important, this is not sufficient to meet the job requirement for being a successful teacher. Because at post-graduate level of their study, students do not get any training that might help them in teaching. Also there is no provision for providing special care who want to go for teaching profession. So a post M.Sc. training course for those who choose teaching as profession, is desirable, so as to provide them with knowledge for presenting the subject matter to the learners. Some knowledge about techniques and methods of teaching would be acquired before one starts teaching. Thus pre-service training is very important which provides acquaintance with some unifying mathematical topic

pertaining to what the teachers would teach, together with some topics in methodology.

The training after recruitment of a teacher is as equally important as the training before recruitment. The revision and change in the content and methods of mathematics course often keep posing new situations, and this calls for creation of some new mathematical techniques. To meet the challenge successfully there should be the scope of inservice training for the teachers, where they will be given information about the new trends and new teaching techniques of mathematics that may help in improving the quality of teaching. This task can be carried out successfully through a variety of programmes, such as Summer course, Week end courses, Workshops, Seminars etc., where the teachers should be required to present papers, undertake project work and prepare teaching-learning materials and teaching aids.

There is no scope of such professional training for college teachers of Meghalaya. Though its value and effectiveness in continuing the training of teachers to a higher place of efficiency and competence are widely recognised, no significant effort in this regard has been observed. Occasionally seminars and workshops on mathematics education are arranged by various organizations, where the teachers bring out their problems and

difficulties for free and frank discussion and also can keep themselves up-to-date in respect of subject matter and teaching techniques. But these are not held as frequently as it should be.

The involvement of the teachers in experiencing mathematical ideas and learning effective ways of communication to students would be extremely fruitful,<sup>7</sup> which can be provided to the teachers by supplying them with various aids in the form of journals, allied books, teaching aids mathematical kits, charts, models, films etc. The college teachers of Meghalaya are always deprived of the most of these aids. A very few institutions in the state have library facilities which can only partly meet the needs of the students but not of the teachers. Mostly they do not contain desired good books, not to speak about journals and other aids.

The defect of teaching system prevailing over the state lies also in the methods of teaching mathematics. The teaching of mathematics over here are only concentrated on the subject matter and students are expected to memorise them. That is why our teaching has become mostly memory-oriented and so it has failed to enable a student to attain the knowledge by logical thinking and reasoning.<sup>8</sup> In most of the institutions of Shillong,

it has been observed that the mathematics teachers tries to explain the situation just by a talk over the topic and some board-works. This becomes a one sided talk, and the students become just attentive listeners, hardly putting any question or arguments. This talk and chalk-method is generally termed as lecture method. It is a fact that in a large class of duration of forty five minutes a teacher cannot adopt a more effective method. In most of the institutions there are no regulations to regulate the size of the class. Report says that there may be as many as 150 to 200 students in a single class of mathematics at + 2 stage in some colleges. So a meaningful communication between teacher and learner cannot be expected and to teach in such a big class, the lecture method seems to be the only way out. But the problem is that in this method it is not at all possible to do proper justice for the subject. Because, mathematics cannot be learned just by being a passive listener. Unless the learner does not adopt the role of active participant, learning of mathematics cannot succeed. Receiving and memorising a bit of information is not the important purpose of mathematics. The study of the subject is more concerned with the thinking and reasoning power. So a method of teaching mathematics where experimentation is totally neglected, where there is no opportunity

for the learners to discover and find out the facts by themselves cannot be the proper teaching method.<sup>9</sup>

The teaching of mathematics in the State of Meghalaya begins as soon as a child enters school. But it was a compulsory subject at lower level only. It has been made compulsory for all at secondary stage very recently by 1983. But, merely making the subject compulsory does not help much in motivating the students. So far as motivation towards the subject is concerned, the State is highly poor. It has led to the unfavourable attitude towards mathematics and has caused an increase in the rate of failure and decrease in number of pupil studying with mathematics in higher classes. Thus, by making the subject compulsory upto secondary stage has not improved the earlier situation and has also not removed the 'backwardness' in mathematics. May be, the students who are weak in mathematics do not get proper training and enough stimulus from the class as well as the social and home environment.

It has been noticed that most of the factors causing backwardness in mathematics are psychological<sup>10</sup> like low I:Q, some mental ailment, mental dissatisfaction, domestic problems, mental conflict, sense of insecurity, inferiority complex etc. These types of mental problems

often give rise to distaste or fear for the subject. However, teachers can help to a large extent in these problems. A genuine taste for the subject is developed through the teacher's patience and persistence. Teaching of mathematics is an art. Few of the teachers have it and most of them have to acquire it. The development of mankind always been dependent to the teachers who handed over the knowledge, acquired through lifetime, to the newer generations. So self-improvement of a teacher means the improvement in the overall teaching learning system of mathematics.

Improvement in teaching has got two important aspects, namely significant knowledge and effective method of conveying them to the students. Undoubtedly, mastery over the subject is the most essential factor that is needed to teach effectively. Not only a degree but also a person's aptitude counts a lot in this profession.

Effective teaching means the effectiveness of the method by which a teacher presents the subject to his pupils. So far as teaching of mathematics is concerned, it has been observed that the drill work helps a lot to gain clear mathematical concepts. Memorising formulae or theories is always been a tiresome job. Drill works

make this process much more interesting. Moreover, effective and meaningful drill does not burden a student with tasks; instead, it enables him to take pleasure in them. If it can be given in various forms it helps in removing the monotony of learning.<sup>11</sup> Another aspect of teaching of mathematics is that instructions in this subject must follow a well ordered sequence. The learners cannot afford to miss any unit; because, once a concept is missed, the loss is irretrievable and its effect is cumulative. Weakness or not understanding at any stage results in difficulty which creates disinterest among the learners. Drill work can remove this difficulty. Thus, drilling as a device of teaching contributes to a large extent in motivating the students towards the subject. However, at +2 stage proper care must be taken to handle drill work. The very short and short answer type of questions can be done through such work orally. This will make the teaching of mathematics more meaningful.

#### 2.1.02. Students Unmotivated

Truly speaking, the defective teaching has caused to create a class of unmotivated students at this stage.

A major aim of teaching mathematics should be to develop habits of logical and rational thinking in

the student and train him to learn on his own.<sup>12</sup> If this goal is achieved, then only a successful step towards the motivation, which means to create a desire and aptitude in students to learn the subject, can be made. But our teaching system could not succeed in this regard. The teachers of mathematics at this level failed miserably to discharge the most important part of their function, namely, to arouse interest in their students. Mathematics has not been presented to the students as an integrated and organized body of beautiful ideas, full of creative excitement and adventure which is being increasingly utilized in the other branches of science. Instead, it has been reduced to a dull mechanical routine affair.<sup>13</sup>

Elementary education in mathematics in Meghalaya is at a deplorable state which has really failed to create motivation among the students. If the arrangements for proper instruction in mathematics in the elementary stage is not brought, even a good beginning at the later stage cannot improve the situation. The lack of motivation is bound to be there at higher stage also. It is a fact that most of the teachers manning the primary school system today have got no proper mathematical background. Even in the M.E. Schools and High Schools of the State, the number of qualified mathematics

teachers is far from meeting the requirement. A survey report<sup>14</sup> shows that only 38.7% of the total mathematics teachers of the schools of Meghalaya have graduated with mathematics as a subject. So, since the students do not get the benefit of right instruction, they gradually lose interest in mathematics. Though the subject is taught as a compulsory subject, they try to shake it off at the earliest opportunity.

### 2.1.03. Defective Admission Policy

Mathematics is an optional subject at plus two level. It has been observed that most of the students opt mathematics either because it is essential to enter into the professional stream or because a degree with mathematics helps in bettering the chances in the job market. Avenues of employment at the end of a mathematics training do not compare favourably with avenues of other subjects which makes many students of low calibre enter the stream of mathematics. This fact increases mediocrity but not motivation among the students.

Recruitment of students at Pre-University is mostly arbitrary. They are admitted on the basis of marks obtained in HSLC examination. But good marks cannot tell definitely about the aptitude of the students towards the subject. Specially when there exists gulf of differences between the two courses of study and it is in Meghalaya.

Problems lies also in the classroom teaching system. Effective instruction cannot be achieved unless the teacher and the students have enough contact within and outside classroom. In a heterogeneous classroom individual attention is not paid to the students. Also as mentioned earlier, in most of the institution there is no regulation in the size of the class. So, in a class where there are too many students, their aptitude and abilities will be different. While teaching in such a class, the teacher remains unaware of the difficulties and needs of every student. Such teaching is mostly suitable for the average students. The group of slow learners or under achiever suffers of the poor foundation whereas the motivated or gifted students who need richer specialisation and deeper understanding in the subject do not get proper individualised attention. As a result, a tendency of drifting away from the subject grows among the students.<sup>15</sup> Motivation of the teachers towards the subject also depends on the method of teaching; that is, how the teacher is putting the subject matter across. In a large class the most common method for a teacher is the lecture method. Specially, when a heavy syllabus is to be finished within limited time there is no other alternative for the teacher. But then the experimentation to find out the learning effect cannot be tried. To create

love for the subject among the students, they must have the opportunity to discover and find out the facts for themselves. Also in a lecture there is a rapid flow of ideas which may be difficult to follow for slow learners. As a result, the motivation of the students cannot be attained to an appreciable degree of success.

#### 2.1.04. Outmoded Curriculum

The course offered to the students at plus two level is not a perfect one. Curriculum plays an important role on the whole educative process. It is that tool by the help of which the objective of education is achieved. So a curriculum has to be so planned that it can meet all the requirements of imparting the knowledge to the learners. Curriculum has two aspects: (i) What is to be taught at different level. The content of the course structure gives answer to this, and (ii) How to teach the topics of the content? Here the way or method of teaching should be specified. Some more questions arise in this context, like, why certain topic should be taught? This is one of the most important aspect that deals with the motivation of the topics included in the syllabus. A curriculum can be said to be well organized, rather perfect, if all the above conditions are fully satisfied. A perfect curriculum should have large framework of regional need and social background of the local students.

The present curriculum offered to the pre-university students of Meghalaya is too rigid. The students have no option in selecting the topics for study. This fact affects in the motivation of the students towards the subject. Unless some flexibility is given to the course, the teaching process alone cannot cater to the individual aptitudes and differences. Since no freedom is given to the students in selecting some of the subject matter, they take refuge of key books or notes available in the market, which are prepared for examination purpose only. So the goal of mathematics education at the stage is not fulfilled due to which, failure<sup>16</sup> creeps in.

Ordinarily, the curriculum is just the listing of the names of the topics. It does not tell anything about the method of teaching neither it gives a proper idea of how far of a topic should be taught at certain level. So the teacher has to develop the details by himself which amounts an excessive expectation from a teacher.

A state should develop its own curricula in mathematics keeping in view the needs, aspiration, general level of education, socio-economic condition of the society along with the goals and objectives of mathematics education.<sup>17</sup> The development of a state depends on the development of these aspects. With the change of these

factors, syllabus must be revised from time to time. By the continuous revision of the prevailing syllabus, enrichment materials can be included which can raise the standard of the syllabus. In Meghalaya, hardly any attempt has been made in this regard, particularly for the syllabus for HSLC examination. Recently the existing syllabus for plus two level have been revised and some changes have been made by the University under P.U. Board. But it is constrained by the old fashioned syllabus of HSLC standard. Due to this a wide gap has been made. This gap created between the content of HSLC syllabus and plus two level syllabus, has caused the mathematics teaching at plus two stage to suffer to a great extent. If the latter should have been the continuation of the former, the teaching would have been meaningful. The students now enters the plus two level with very poor mathematical background and so mathematics appears to be difficult at this stage. As a result, the teaching in general has failed to create love for the subject among the students.

It is mentioned earlier that the curriculum should include a well integrated treatment of the mathematical and social phases of the subject. The content of curriculum should be based on the need of the society and community of the region.<sup>18</sup> While making a new syllabus, or revising

an old syllabus for an mathematically backward state like Meghalaya, the capability and the foundation of mathematics of the local people must not be forgotten. From that point of view, a bit of adjustment in the standard of the prevailing HSLC syllabus compared to the national level may be meaningful. But the question is whether this should be an excuse for not revising the syllabus for long time. Mathematics has been developed a lot during the last four decades. Unfortunately, the people of this State are not exposed to it. Within the framework of regional barrier, the present syllabus can be improved by revising it more frequently and by making small changes at each revision. Such a process of revision of the syllabus from time to time would help the students to get acquainted with the current growth of mathematics and it would have been an effective step to improve the backwardness in mathematics.

Additionally, the present mathematics syllabus does not find correlation of a topic with other topic in other branches of science. It does not show even the correlation within the topics of mathematics itself. Correlation is the most essential factor that makes the study of the subject meaningful to the learners. Correlation with other subject convinces the learner that knowledge

acquired is ultimately one and the same and the knowledge of one branch helps in learning the other branches. Then they will realise that mathematics provides for quantitative study of various subjects and the mathematical way of looking at them gives exactness in thinking. Correlation with day to day experience brings out the power of mathematics in application and convinces a learner that it is immediately useful even in discharging his duties as an enlightened citizen. It takes the learning of mathematics out of the four walls of a classroom to the wider sphere of activity. Thus, this integration is essential to communicate to the learner that mathematics transcends the pages of his textbooks and it is a part and parcel of his life.<sup>19</sup> From this, it is very clear that the integrated study of mathematics contribute fairly towards the motivation of the learner. Also this method of presenting the subject will help the learner in developing mathematical way of looking at things and thus mathematics will itself become a meaningful part of his life. But the present plus two syllabus do not suggest such integrated approach of studying mathematics. A project report<sup>20</sup> indicates how science uses mathematics and what are the basic problems encountered by science teachers regarding the mathematical ability of pupils. The findings of this project are: (i) the lack of transfer of mathematical skill learned in

mathematical lesson to the science lesson, (ii) the feeling on the part of science teachers that the computational skill are lacking in pupil at present. Such difficulties can be removed if integrated approach of study of the subject is encouraged from the very beginning.<sup>21</sup>

#### 2.1.05. The Problem of Textbooks

The successful implementation of a syllabus depends on the prescribed textbooks. Traditionally, the textbook is the most commonly used instructional material. In Meghalaya, it is rather the only instructional material. No doubt, textbooks are very important in the field of educative process. Without textbooks the job of teaching would not have been carried out successfully. Because, it serves as the most useful resource even to the teachers. Teachers find significant advantage in the textbook. In a textbook, generally, a great quantity of valuable information is summarised in a manner that is convenient for both the teacher and the students. A good textbook furnishes a large collection of well selected and graded exercises for the teaching as well as learning. Also, in many cases it includes figures, charts, maps, flow-diagrams which may prove to be valuable in teaching mathematics.

But in spite of all its importances, the textbook has some demerits also. Firstly, it comes from the author

of the text. An author may be well expert in his field and the material may have been pre-tested, yet texts written may not be serving the local needs. Because, the books are published for national distribution. It does not (and cannot) take into consideration the nature of the local community. And it has happened here. Textbooks should be written by the mathematician who has the first-hand experience of the teaching in the region. When the author is familiar to the defects and drawbacks of the local students, he can take care of these in his book. In this state, the problem of textbooks is envisaged by the educative system as a whole. There is hardly any mathematics book written by a person having experience of teaching in the state.

Moreover, the textbooks are generally written for average learner. So the two extreme classes find these books to have differences in academic aptitude, interest, background of experience or goal of learning. Some adjustment for individual differences is necessary. A group of research worker<sup>22</sup> while working on instructional material in mathematics found that the textual material neither provides scope for exploiting the creativeness of brighter students nor it helps in diagnosing slow learners providing remedial materials. Since the textbooks is bound to follow a prescribed syllabus and the requirements of examination, there is no room for any type of enrichment

material in it. So, the need for instructional material to supplement the textbook both for teacher and the students is obvious. In fact, no textbook can be complete if it does not contain typical exercises together with some exercises for specially gifted students. The purpose of a good textbook is to present material to be acquired under the direct guidance of the teacher and acquisition on the part of students has to be gradually automatic so that the gifted students need a minimum help and that the teacher can direct his attention to the slow learners. But the students of Meghalaya has so far been deprived of such textbooks. One more drawback of the prescribed textbooks at present are that they do not meet the requirements of competitive examination for the entry to engineering, management and other professions. This is a reason for the less numbers of students who can come out with flying colours in the field of technology, management etc.

It is often said that a textbook, though very important among the instructional aids is not adequate in itself to help the students to acquire the expected learning in terms of knowledge, understanding, skill etc. It needs to be supported by other aids like test items, charts, models, film strips etc., to further explain and concretise various concepts. Audio-visual aids are a great

advantage to the classroom teacher.<sup>23</sup> Because, they are the learning materials which show great promise for making learning more important and effective for the students. Unfortunately, the teachers of Meghalaya do not get the scope of exploring such audio visual aids to the students.

An important function of every educative institution is to provide the learners with extra information and supplementary material in addition to the classroom teaching. A good library can serve the purpose successfully. If it is not possible to take individual care in the class, then also a good library can help the learners in this respect at least to some extent. It should ideally contain various textbooks other than prescribed one, reference books, supplementary books on some related advanced topics, various mathematical journals and magazines that helps to keep in touch with the various development taking place in the different fields of Mathematics etc. These would help the brighter students. Whereas, for slow learners a collection of remedial notes on the topics, some current popular books etc. are desirable. For the teachers of mathematics, teaching modules, illustration of mathematical application in various fields, the books on practical teaching of the subject, journals etc. should be there.

In spite of all the above mentioned things there must be a good number of the prescribed textbooks in the library to make it available to everyone.

So far as motivation of the pupils are concerned, a library may help in this regard by keeping various books of Mathematical hobbies, recreational mathematics, mathematical puzzle books etc. Equally books on history of mathematics and biography of noted mathematicians would be of good help.

Factually, almost all the colleges in this State has been failing to provide the adequate library facilities. Library is very poor even in the 'good' colleges. The quality as well as the quantity of the books in the college libraries are not upto the requirements of the students. Also the education being examination oriented, the college libraries are stacked with substandard books which are useful to the students only for preparing themselves for examination, but which do not widen the horizon of mathematics, and thus has failed to develop a taste for mathematics. Since the number of students studying with mathematics, and the people who uses mathematics are very few compared to the number of students in other disciplines in this region, neither the libraries nor the bookshops have enough good books or newly published books

on the subject. The libraries do not even contain any journal or magazine on popular mathematics. Unless the libraries are improved, habit of studying, particularly the habit of self learning cannot grow among the students and so the right education in mathematics, in the broader sense of the term, cannot be achieved.

#### 2.1.06. Defective Examination System

The success of teaching-learning process in mathematics depends upon the proper system of evaluation. After a student is taught the prescribed course it is required to assess whether he has attained the knowledge; whether the goal of teaching the goal of teaching the prescribed course is achieved or not. Thus, evaluation is inevitable. The teacher should be concerned with what is happening to the total personality of his students; that is, he is the one to judge whether his guidance is helping his students to develop their mathematical skill, the problem of solving, the habit of critical thinking and reasoning power in all types of situations etc. But one thing must be noted that the process of evaluation is not a task of the teacher alone.

Students and teachers co-operate each other in four ways: (i) in establishing goals, (ii) in planning activities that will guarantee the desired growth, and

(iii) in securing evidence of progress.<sup>24</sup> Thus a student with the help of the teacher learns his strength and weakness and is assisted in interpreting the learning experiences.

Apart from teachers and students, the parents also contribute significantly towards the process of evaluation. Because, they are in a position to observe the evidences of learning outside the classroom and thus be in a better position to judge the overall education of their wards than the teachers.<sup>25</sup> Thus, evaluation is the integral part of teaching learning process.

In our country, examination is the only device of evaluation. Examination, as we all know, is a process by which the knowledge, ability and skill of the student can be measured with the help of a question paper containing some selected questions of the course. None can deny the importance and usefulness of the examination. It helps teachers to judge his standard of teaching so that they can change or rearrange their guidance programme according to the need of the students. Guardians also can assess the achievement of the students by the result of the examination. Above all, it enables the students to evaluate themselves and makes them aware of their weaknesses.

But unfortunately the system of examination has failed to attain its goal. Or, in other words, it has defeated the mathematics education. They are two distinct process, both are part of teaching learning process and certainly evaluation is not the objective of education. In the undergraduate level major defects of examination system lies in its rigidity and not flexibility. Conventional examination system is such as to give high weightage to those who memorise "Mathematics Made Easy" and examination oriented books so that most students at the end of the training are no better than before. Consequently, many are ignorant of basic principles of mathematics. A study on the University result for last few years reveals the fact that the number of successful students in mathematics is generally less than 50%.\* If this is the case, the drawbacks of the examination system must be taken into consideration. The aim of examination is to evaluate how far the students know and to what extent they have acquired knowledge in the subject. It does not attempt to evaluate the understanding and grasp of the concepts learnt. That is why few selected topics thoroughly memorised, the students can secure pass marks. A major portion of the syllabus is left untouched. It is seen that a set of selected questions are often asked to test only the bookish knowledge and not the mathematical skill or the actual grasp over the subject. So the teachers

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\*Vide Table - 5.

FIGURE 2

Figure Showing The Rate Of Failure In Mathematics At P.U. Examination In NEHU.

→ Students Appeared With Mathematics.  
→ Students Passed With Mathematics.



need not bother to teach thoroughly. It is enough to try to make them get through the examination. This attitude grown through the defective examining system has resulted in a heavy failure and consequently the students' enthusiasm and interest are damped. Examination has become a matter of chance more in mathematics than in any other subject. It has failed to depict the true picture of a student's ability in the subject. Thus as long as such a defective examination system dominates, improvement in proper teaching of mathematics cannot even be dreamt of. So modern improved device of evaluation must replace the traditional examination system and this could be one of the expected remedies of mathematically handicapped.

#### 2.1.07. Backwardness of the Area

The most important reason affecting this region's mathematics education is the overall economic and technological backwardness of the state. It is a fact that the rich natural resources of this State has hardly been utilised. Their full potential remains even to be fairly assessed. The only reason for this is that the state is lacking of technical manpower. Though the hill areas in the region have attained comparatively higher, literacy level, yet mathematics and science education has not been developed remarkably from its very beginning.

Education came in these hill regions as early as the beginning of this century or even before that. A report says that, in 1813, the 1st missionary came to the Khasi Hills. In 1836, Rev. Brown and T. Cutter of American Baptist mission came to Assam. They brought with them a printing press with a view to spreading Christianity in the hill areas. But due to some political disturbances they had to leave the hill areas and started their work in the plain areas of Assam.<sup>26</sup>

Incidentally, it was not much later than that when missionaries came to these hill areas and started spreading education among hill people. More and more schools were established in the region. The spread for educational institute for higher learning also became wider day by day. But in spite of all these science and mathematics education did not receive the due attention it deserved. Because, education in this region began with an objective of spreading Christianity and increasing administrative manpower to meet the requirements of the then Government. In many places mathematics was not taught at all. On some occasion it was taught just enough to meet the practical necessity for day to day life. The education become synonymous of mere verbal literacy which may enable the people only to read religious books, fiction

etc. Even today, that is, nearly after half a century the condition is no better.

However, various measures have been taken to improve the situation. Some number of seats have been reserved for the students of the state in most of the technical institutions of the country. Yet the intake of students from the area in the professional courses is very limited. Similarly, the number of students in the pure science stream even in the North-Eastern Hill University is very low, (vide Appendix. II)

The factors causing the so called backwardness in mathematics can be broadly classified into three categories; namely, (i) Social or community factor, (ii) Individual factor, and (iii) Institutional factor.

#### (1) Social Factor

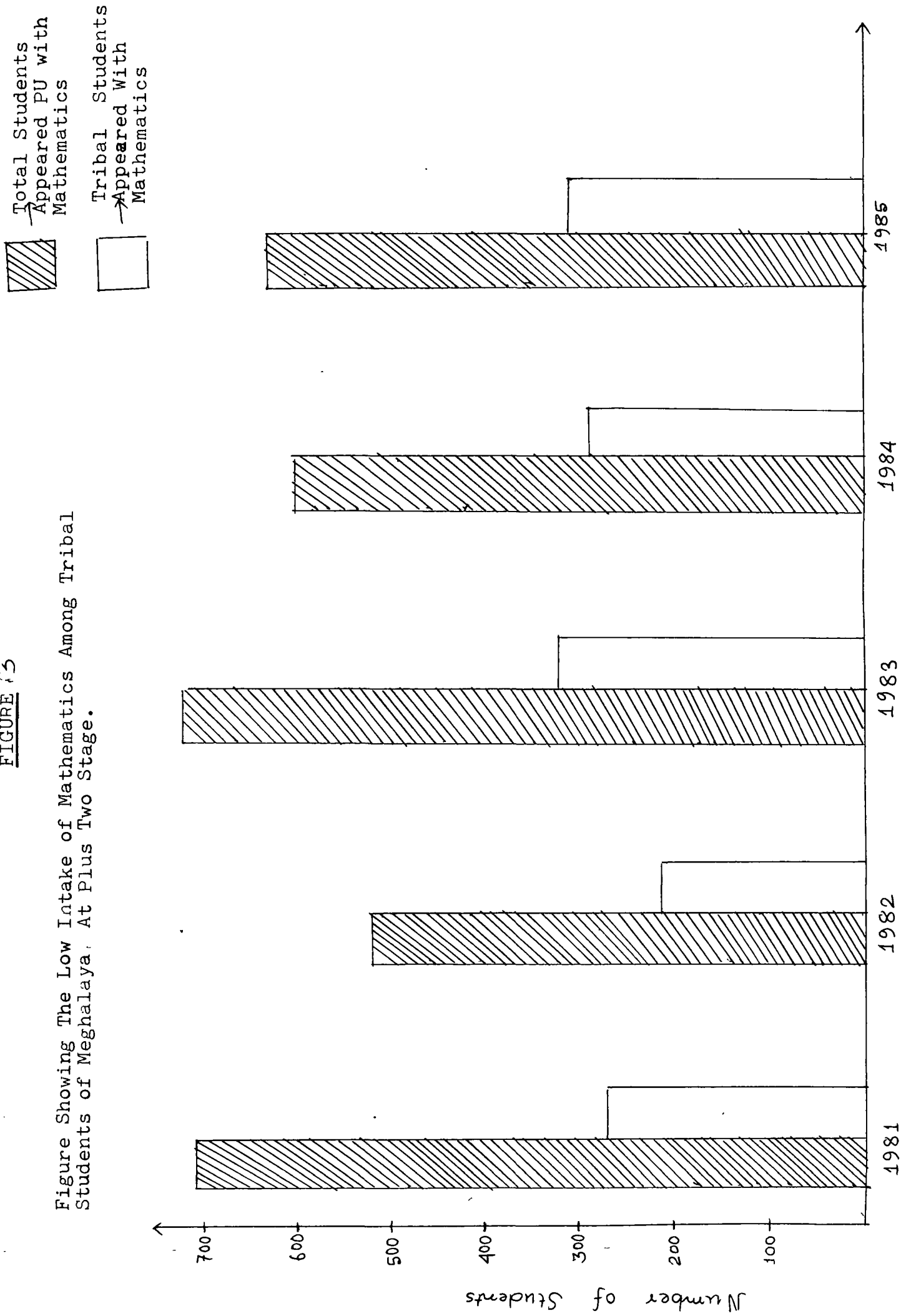
The Society as well as the family in which a person is born imposes the maximum influence on his life either directly or indirectly. It is true that social heritage is not very abstract or constant. It undergoes reformation from time to time. Yet the customs, laws, outlooks, and tradition of the community descend from generation to generation. Thus, when some particular idea or notion is being conveyed from generation to generation,

it is not very easy to uproot that. The same thing has happened with learning of mathematics among the hill peoples of Meghalaya. Older generation believe that mathematics is a dry, dull and abstract subject which causes the younger generation to keep away from mathematics. Earlier, they had an idea that mathematics is just a process of counting which children learn naturally. Then came the educated elite group who felt that mathematics is something abstract, which requires perseverance and extra intelligence. The rest of the people remained confined in their own world, a world of plain and simple living on the hill top and being unaware of the world-wide development through centuries. They could see no application of mathematics except counting and doing some business. Thus, the idea of abstractness of mathematics grew among them and eventually they found no valid reason of learning mathematics at higher stage.

But education remains incomplete without science and mathematics. So it became necessary to introduce science education at different level. Incidentally, our educationists could not motivate the local students towards science and mathematics education. Presently, although the necessity of learning mathematics has been realized by the tribal students of the state, the beauty and charm

FIGURE 7.5

Figure Showing The Low Intake of Mathematics Among Tribal Students of Meghalaya, At Plus Two Stage.



of the subject is yet to be felt by them. Till now this is a 'dry and dull' subject to them which requires more work and consequently easy going student do not feel the need to opt for science and mathematics education. And such an impression is often carried out to the youngsters by their elders.

#### (ii) Individual Factor

It has been observed that the students from hill tribes who opt for mathematics generally consider the subject to be difficult. Most of them are found to be quite good in other subjects but lagging behind only in mathematics due to fear psychosis. Fear complex retard their interest and capability. Moreover, it is often believed enormously that mathematics requires an inheritable special ability and our tribal students are lacking in it. Such attitude has been arising perhaps due to the fact that we do occasionally find students who are good in mathematics but not equally good in other subjects. Whatever be the reason may be, this idea is totally wrong. What they are lacking is the interest or love for the subject and nothing else. Once they find it to be interesting, so called mathematical ability will automatically grow in them. The thought of lacking this ability also keeps the students away from mathematics. And the condition

will not show any improve unless this wrong idea is removed from the minds of the students as well as the community.

There are, of course, some students whose I.Q. is low due to which they may be weak in mathematics. But this defect can also be removed to an appreciable extent by the joint effort of teachers and parents. The influence of home is most important for such a class of student.

True that home environment plays an important role so far as education is concerned.<sup>28</sup> Probably this could be a reason for which mathematics education in tribal areas has failed to attain an appreciable degree. Even today, most of our tribal children particularly in rural areas lack a good home environment for study. A number of studies separately made by Adaval et al., B.N.K. Singh and Dhaliwal in the middle of this century established the fact that a student stays in school or college for about six hours and the most of the remaining eighteen hours he spends at home and its neighbourhood. If his surroundings do not act as a catalyst for promoting his educational experiences, the rate of learning is bound to slow down. Thus it is often found that educated parents can give their children a better home environment to study. That is why, it takes generations to spread education among a community. Various works

done by Singh (1965),<sup>29</sup> Chopra (1964),<sup>30</sup> Adaval et al. (1961),<sup>31</sup> and Srivastava (1967)<sup>32</sup> show that the learning difficulties are inversely proportional to the education and occupation of the parents. Thus, the environment of the student makes much matter in learning a subject, specially science subjects like mathematics. In no case the student should get the idea that mathematics is a dull and difficult subject. A student should not be told that he or she is weak in it. By improving the environment of an individual, the better potentialities can be developed.

Mathematics teaching in colleges in the State has been suffering from a major defect, namely, unfavourable teacher-student ratio. Often the class is too large. The number of teachers is much less compared to the number of students as a result of which the work load of a teacher becomes heavier than what it should be. It has caused the mathematics teaching to suffer from the lack of individual attention. In a big class it is not always possible to remove personal doubts and difficulties. An well known feature of mathematics education is that the instruction in the subject has to be in a well-ordered sequence adding to the skills and knowledge of the students unit by unit. One cannot afford to miss even a single unit; because,

once a step at any stage is missed the loss is irretrievable and its effect is cumulative. Slightest weakness at any stage may result in difficulty in comprehension and finally the student begins to get disinterest for the subject. Our tribal students are naturally reluctant to mathematics and once a distaste for the subject is grown they simply tries to get rid of it.

Meghalaya is a state which consists of mostly villages and only few towns. It is often said that rural tribal students are very irregular in attending their classes. Before we blame them, let us have a look at the factors causing this irregularity.

Firstly, most of the children is often required to work at home because life is very hard in the villages. They hardly get any time for their study and school going becomes almost a pastime for them. And due to this, they lag behind in their regular studies, fails to complete homeworks etc. specially in mathematics. As a result of this, they become hesitant to go to the class and finally become a drop-out.

Secondly, in villages mostly schools are situated very far. The students have to travel a long distant on foot to come to the school. So too much of physical strain

affects the studies of a student. As we know, the roads in hilly villages are not enough smooth or straight. No remarkable efforts has been noticed from Government's side to improve the situation. It is reported that 90% of the primary schools are located at least in 1 Km distance, about 60% of the middle schools are located at 3 Km distance, and 35% of the high schools are located at 4 Km distance. Colleges are situated only in towns. Students are to manage somehow their stay in towns for college studies, specially for science (and mathematics) education and it often becomes too expensive to afford for the poor villagers.

Thirdly, lack of understanding in the class causes another factor for the student to grow a distance for the subject like mathematics. When a student fails to grasp the basic concepts or fundamental processes in mathematics, naturally they begin to repel the subject. This is also another reason which makes them irregular in class and reluctant to learn mathematics. Finally, they prefer to give up the subject and go for non-mathematical stream.

### (iii) Institutional Factor

Apart from the factors stated above, there is another factor which may be the most important factor

causing backwardness in mathematics education in the state. It is termed as institutional factor. When a student enters institutions he should get proper guidance and adequate institutional facilities. If he is deprived of such facilities, the basis of his education cannot form properly. Therefore, when we discuss about the teaching-learning process at +2 level, we must not ignore the very root of the problem. That is the problem of the teaching of mathematics at school level.

Inefficient teaching particularly at school level is not a problem of Meghalaya only but it is a problem of entire north eastern hill region. Perhaps, it is the most effecting problem which has received the least attention so far. No single agency can be blamed for it; rather the whole educational set up is responsible for this. Let us have a critical look at each of the constraints of this: The system faces the first problem regarding the mathematics teachers of the institutions of the state. Kothari Education Commission report says, "Of all the factors which determine the quality of education and its contribution to the national development, the teacher is undoubtedly the most important. It is on his personal qualities and characters, his educational qualification and professional completeness that the success of all educational endeavour must ultimately, depend."<sup>33</sup>

Yes, a teacher's duty is not only to impart bookish knowledge but also to help the student to develop his personality within himself. Thus a teacher must have the knowledge about his student's psychology, his social and cultural life, his likings, his weakness etc. in order to guide his intellect in the proper way. Rousseau<sup>34</sup> said that the child is a book which the teacher has to learn from page to page.

The very first criterion of a successful teacher is his command over the subject he teaches. An adequate qualification of the teacher develops self confidence within himself and serves as a source of inspiration to his student. School teacher's qualification in the State of Meghalaya is one of the most major defect in the educational set up right from the primary stage, although this is not the case at plus two stage. From a survey work regarding the qualification of teachers teaching mathematics at different levels in schools, it is found that almost 80% of our schools are lacking in properly qualified teachers not to speak of trained teachers.<sup>95</sup> Without proper qualification and proper training, they fail to do justice to the subject and the subject is taught mechanically so that the students do not recognise the purpose behind the study of the topics of mathematics. That is why the

school teachers in Meghalaya have not been able to impart their first and foremost duty ably to make the subject acceptable to their students. Most of the teachers teaching mathematics in schools have got no proper mathematical background. In most of the rural schools even at the high school level, the practice of engaging teachers subject-wise is not well-established. A renowned mathematician of the region expresses his views as: "Pupil, in general, find mathematics in the secondary stage difficult. Most pupil offer mathematics at the collegiate level as an optional subject and in the degree course the number of students with mathematics reasons of shortage of the qualified teachers in mathematics."<sup>36</sup> Whatever be the reason, the effect is a very far-reaching one. Since most of the teachers at elementary, middle and high schools do not have proper training it is not possible for the school system to provide adequately for mathematics and science education in schools. So, there is a growing divergence between the attainments of the students and the requirements of higher mathematics education. The students in colleges are thus compelled to opt for softer courses because of their poor foundation in mathematics.

The number of mathematics teachers in schools or even in some colleges are inadequate to meet the requirements. Primary schools, particularly in rural areas has

got only one or two teachers per school. In many middle and high schools there is hardly any separate science or mathematics teachers. Mostly they are teachers with general qualifications. Some of them are even from arts stream. There is no proper student-teacher ratio for which crucial aspect of mathematics education in Meghalaya has been created. It is a fact that no significant improvement in teaching of mathematics is feasible unless there is meaningful communication between the teachers and the students.<sup>37</sup> Surprisingly, there is no regulation to regulate such anomaly not only in the schools but also in the colleges under the University. There may be as many as 150 to 200 students in a section of mathematics class at P.U. standard. As a result, it is not possible to have direct communication between teachers and students.

Besides, insufficient number of teachers in our institutions made the existing set of teachers overburdened on all sides. As a result, he follows mechanical teaching methodology. He does not bother for homework or class assessment. It becomes a practice for him to follow the way of least resistance. He emphasises cram work. His work load does not allow him to show his originality and initiative or to adopt individualized plan of teaching.<sup>38</sup>

It is observed that due to the dearth of good teachers in our school, a class of teachers have been forced by circumstances to teach mathematics. They have no genuine love for mathematics, neither for their profession. One reason for this could be to make him a frustrated, disconnected and half-hearted workers. If possible, he looks for a better job or he runs after other activities to supplement his income like private tutions etc. Due to all these, a teacher lacking faith and utility of mathematics fails to teach effectively with interest. Really anxious and willing persons can only give their best service as a teacher to the learner.

As discussed earlier the present day teaching of mathematics in Meghalaya is such that the learners cannot recognise the purpose of learning mathematics. And so they are not enthusiastic to learn the subject. Not only the students, even their guardians have a misconception that most of the topics that is taught in school level is not purposeful.<sup>39</sup> Another aspect is that in the whole of North Eastern Region there is no placement information facility due to which many bright and hopeful students have failed to know on what disciplines they can pursue their higher studies after plus two stage. The students as well as their guardians are here almost ignorant about

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what kind of career one can choose with what background, and in what way the knowledge of mathematics can be utilised.

True that inefficient teaching is a factor which gave birth to the notion of disliking mathematics. But this is not the only factor. No effort has so far been marked to popularise mathematics. There is a serious lack of facilities, equipments, books etc. Almost in all schools of Meghalaya practically there is no library. In colleges there is library where the number of books is far from meeting the requirements. Also the students do not have the habit to enjoy the complete library facilities. There is no good mathematical aids, kits, and other instruments which can help in exercising the originality among the students.

Also the teachers face the lack of libraries. There is very little scope for them to come across the newly published books and various journals etc. So they are not well-informed about the latest trends in teaching of mathematics and mathematics education. Besides, they are hardly exposed to seminars workshops and conferences in mathematics and mathematics education. It is a fact that the North Eastern Region as a whole being placed geographically in a strategic corner is lacking in such

facilities due to the communication gap. Of course, this is not a very acute problem which cannot be removed. But no step has been taken to overcome this upto now.

Another problem faced by the teachers of this region is that there is no scope for inservice or pre-service training in mathematics. As a result, the teachers are clinging to traditional methods for which the power of thinking, understanding and retention are not developed in the students. There has been some researches about the method of teaching mathematics. The use of such method of teaching mathematics in the class was first indicated by Perry in England and Morpe in USA. The modern method would be "first to give the pupil some specific problems as practicable as possible leading upto theorem in question. This is to be continued until the pupil himself announces the theorem and sees the need for its rigorous proof."<sup>40</sup>

Stereotypically teaching of mathematics have erased the slow learner group also killed the interest of the gifted class among the tribal students.

A study was made by Dr. Dev Sharma (1983) on the major problems confronting out tribal students with regards to their attitude towards learning mathematics. His findings can be summarised as follows:

1. There is lack of proper scientific environment for learning the subject.
2. There is inherent fear psychosis among the tribal students about mathematics.
3. Inefficient and improper teaching through untrained, unqualified teachers have made them frustrated.
4. Stereotype teaching of mathematics through traditional methods has made the subject prosaic.
5. Present examination system directs the teachers to adopt the teaching of mathematics more memory oriented.
6. There is lack of atmosphere of mathematical rather scientific culture in the society.
7. There is lack of proper facilities in the schools and colleges.

Besides, there are few more factors which are responsible for the poor status of mathematics education in the State. Firstly, the less number of colleges offers mathematics and science. There are only 14 colleges in Meghalaya. All most all the colleges are situated in towns. Out of these, only eight colleges offer science. This picture clearly shows the negligence towards the rural

community of the state as regards to Science education. The 1981 Census Report says that the total population of the State is 13,28,343; out of which only 2,39,501 resides in town and rest 10,88,501 are villagers. That is, only 18.03% of the total population of the State forms the urban community for whom the bell of Science education tolls!

Another problem faced by the State so far as mathematics teaching is concerned is the difficulty to recruit teachers, both in school and colleges. The problem is more acute in villages and remote parts of the state. Very few qualified local manpower is available to teach mathematics. Low percentage of intake of mathematics at college level might be the obvious reason for this.

Though full of potentialities, the industrial growth in the State is very very slow. The want of industrialisation of the area is also indirectly responsible for ill-motivation of the local people towards mathematics and science. In order to attract students towards mathematics education, industries, technologies and scientific research institutes should grow in the state where mathematics is used extensively. However, Government has recently taken steps to industrialise the State. But industrialisation and skilled technical manpower are so related that

that the former cannot grow without the latter. Thus, growth is not being accelerated. It is a fact that mathematics have generally been considered as a difficult subject by the students of all over the country. The continuous poor achievement of the students in the subject has made worried the educationists. Consequently, many studies have been made in this regard. A brief summary of some of the findings of above mentioned studies are due to Patel (1967) and Pandhy (1976)<sup>42</sup> conducted studies related to the intelligence. It is found to effect on poor achievement of the students. The outcome of these studies are:

- (i) Intelligent students can solve the mathematical problems successfully which provides him with self-confidence. They can understand the principles and concepts easily. Also they develop good study habits and string reasoning power.
- (ii) On the other hand, a poor performer is humiliated in class or outside, which increase the failure in the subject. Thus, he develops inferiority complex and becomes the victim of the belief that the subject is not for him and he can never improve his achievement.
- (iii) It is generally found that high achievers possess superior intelligence than the low achievers.

Rao in 1967<sup>43</sup> conducted a study on remedial teaching in mathematics. He classified the difficulties encountered by a student in learning mathematics into three categories, viz.:

1. Difficulty in understanding the concepts and principles in mathematics.
2. Difficulty in mastering the fundamental process and skills in computation.
3. Difficulty in Problem solving.

Very often these difficulties are found to occur simultaneously.

His studies also reveal that the causes of these difficulties are as follows:

- (i) Not learning the fundamental facts properly.
- (ii) Not being able to substitute properly.
- (iii) Carelessness resulting in wrong copying and carry overs etc. i.e. common errors.
- (iv) Lack of computational skill.

Among the poor achiever he came across two types of students. They are firstly, the students who are not able to comprehend the problem but are well up in all the computational skill. Secondly, the students who are

able to comprehend the problem but cannot solve it completely due to the lack of computational skill or due to the lack of knowledge of application.

Somasundaram and Rao (1965),<sup>44</sup> Byanwala (1966),<sup>45</sup> Joshi (1970)<sup>46</sup> and Gupta (1972)<sup>47</sup> conducted studies related to the failure of pupils in mathematics. Some of the major findings of the above studies are: (i) Non-understanding of the concept of mathematics is one of the major factors affecting ability in problem solving, (ii) The attitude towards homework is a significant factor in the study of mathematics, (iii) Unhappiness is a positive source of scholastic backwardness of the pupils.

Lalithannama in 1978<sup>48</sup> conducted a study on relationship of intelligence and interest to achievement in mathematics. Her findings reveal that there exists a positive relationship between interest in mathematics and achievement in the subject. Interest in mathematics and their intelligence influences their mathematics achievement; for example, success and failure.

Jain (1965),<sup>49</sup> Balasubramaniam (1966),<sup>50</sup> Agarwal and Saini (1969),<sup>51</sup> and Madusudan and Rao (1975)<sup>52</sup> conducted studies on some factors related to performance in mathematics. Their studies revealed that the influence of home

environment on achievement in mathematics was positive. The emotional tone of the home becomes the greatest if followed by physical conditions. Secondly, the educational status of the families exerts a favourable influence on the achievement of the pupils in mathematics, particularly, in rural areas. The other findings of the above studies are as follows:

- (i) Home affairs which are not conducive disturb students in studies.
  - (ii) Lack of school facilities is a very important factor for retardation in mathematical studies.
  - (iii) Poor support from parents on account of illiteracy or poverty etc. affects in their studies.
  - (iv) Emotional problems discourage pupils, and
  - (v) Fatigue and ill health of a student influence his studies to an appreciable extent.
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CHAPTER - III

PLUS TWO CURRICULUM IN MATHEMATICS IN MEGHALAYA

## PLUS TWO CURRICULUM IN MATHEMATICS IN MEGHALAYA

### 3.1. Meaning and Various Aspects of a Curriculum

By the term 'curriculum', which is a Latin Word, we mean the content material, that is the material of the subject matter which is to be studied at a definite level, within a definite period of time. Cunningham defined curriculum as the tool in the hand of an artist (the teacher), to mould his material (the pupil) according to the ideal (objective) in his studio (the school). In mathematics also, the curriculum occupies an important place as it provides with a definite structure of the subject matter that is to be studied. Because the very first question related to the teaching-learning process is 'what is to be taught?' And a curriculum answers to this question. Thus curriculum acts as the most important ingredient of the educative process.

Curriculum has to be constructed and planned in a scientific manner, according to the psycho-physical requirement of the students. For this it has to undergo two phases; namely,

- (i) Selection of the curriculum.
- (ii) Organisation of the material.

In mathematics, an well planned curriculum is very essential to derive the maximum benefit. According

to J.W.A. Young, the selection of the subject matter of the curriculum in Mathematics has to be guided by the following principles.

1. To exhibit most clearly and to best advantages the mathematical thoughts.
2. To help to a better understanding of the laws of nature.
3. To bring out distinctly the mathematical relationships that exist in the social organism and in the activities of modern life, and to show how mathematics aids in solving their problems.
4. To give sufficient skill in actual performance of mathematical process to meet the future need of.
5. To permit the organisation of the material into a homogeneous whole meeting the demand of the scientific pedagogy.<sup>1</sup>

A curriculum is to be made in view of its manifold impacts on society. Firstly, its impact on common people whose formal use of mathematics is minimum.<sup>2</sup> Keeping this aspect in view, mathematics curriculum for schools are made, since mathematics is a compulsory subject upto HSLC examination. In Meghalaya also mathematics has been made

compulsory with effect from 1983 for everybody, irrespective of boys and girls.

Secondly, its impact on those who will use mathematics in various fields like industries, scientific and technical institutions, and Government etc. Thirdly, on those who will teach mathematics at different levels and finally, on those who will advance mathematics as an optional subject. So a mathematics curriculum has to meet the need of all these groups. So a careful selection of materials must be there in the curriculum to make it well-balanced.

An equally important factor like the content is the way of presentation of the subject. The teaching of mathematics should include the basic principles of various topics and its connection with the application in the real world. In other words, the students should know the motives and the applications of what they are learning in course of their studies, so that a sound mathematical reasoning power and self reliance grow in them.

Principle of correlation is a vital point of a curriculum.<sup>3</sup> The purpose of teaching mathematics becomes meaningful only when it points out its correlation with other subjects in Science and Humanities and also with

different branches of mathematics. There must also be a logical sequence or continuity in the different topics of a particular branch of mathematics. Besides these, a curriculum in mathematics becomes complete only when it covers the following aspects.<sup>2</sup>

(a) Course material for recreational mathematics:

If a student is taught mathematics through recreation, it will enable him to learn the subject matter in a playway method. A curriculum should give this opportunity to the students, which having a recreational as well as educative value helps to create love for the subject among the learners.

(b) Principle of activity: Mathematics should be used in different phases of activity. In organizing the subject matter of a curriculum care should be taken for the following activities:

- (i) Personal and home activities.
- (ii) Recreational activities.
- (iii) Vocational activities.
- (iv) Community civic and social activities.
- (v) National activities.

### 3.2 Structure of the Present Mathematics Curriculum at Plus Two Stage in Meghalaya

Keeping in view these aspects let us have an analytic study of the prevailing syllabus at +2 level in Meghalaya. At present the whole mathematics curriculum at plus two stage is completed in three papers. The first paper comprises of Algebra and trigonometry. Second paper contains elementary calculus and co-ordinate geometry of two dimension and in third paper there are vectors and mechanics. Coming to the first paper, the syllabus in algebra contains six units. In the first unit there are simple algebraic concepts of Indices, Surds, problems on variation and a detailed study on logarithm. In this unit the concept of complex variable is also introduced. Operations like addition, subtraction, multiplication and division and geometrical representation of complex numbers through Argand diagram is to be learnt. The second unit emphasizes on progressions (Arithmetic, Geometric and Harmonic) and their application. Third unit deals with quadratic equations, inequations and expressions. Problems on partial fractions also included in this unit. Next unit deals with determinants. Fifth unit includes the detailed study of permutation combination and binomial theorem. In the last chapter, the theorem is to be done. Last unit deals with concepts of functions, their graphs.

Graphs of logarithmic and exponential functions are included though explicit definitions of exponential function is not expected to know.

The syllabus do not emphasises on the study of number-system. At least elementary definitions and properties should have been included. Another incompleteness of the algebra course is that the study of set theory is not included although set theory forms the base of modern mathematics today. The conception of function is desired to give as the 'correspondence' between the elements of two sets. But unless a clear idea of sets is introduced, the teaching of function and its concepts do not seem to meaningful.

The other group of this paper contains plane trigonometry. Here the first unit deals with the measures of angles in different systems and further includes trigonometrical ratios with their mutual relationships, deduction of the values of trigonometrical ratios of the standard angles. The next includes the definition of circular function and their functional equivalence with trigonometrical ratios. This is very important. Earlier, only circular functions through classical approach were taught. But now the students can correlate these two approaches as they are exposed to both the approaches. Various trigonometrical identities are also included. Problems on

heights and distances are also included and it shows the practical utility of trigonometry. The rest of trigonometry syllabus include solution of trigonometrical equation, inverse trigonometric functions, properties of triangles, summation of series of sines and cosines with angles in A.P. That is all about trigonometry which is sufficient for +2 level and meets the needs of the students of all categories.

The second paper contains calculus and co-ordinate geometry. In calculus firstly the elementary concepts are included. For example, real valued functions along with their graph elementary ideas and geometric conception of limit and continuity are there. In the chapter of continuity different types of discontinuity is also included. Next is derivatives. Here, there are evaluation of derivative of some standard functions like  $x^n$ , trigonometric, exponential and logarithmic functions from definition of derivatives, formulas of differentiation and application of those, chain rule of differentiation, differentiation of inverse trigonometric functions, implicit functions and parametric functions.

The course also includes derivative as rate measurer, geometrical interpretation of derivatives, tangents and normals, maxima, minima, idea of monotonic functions.

The last two chapters include only working rule and statement respectively.

The course on integral calculus includes fundamental rules of integration, integration of polynomial exponential functions, trigonometric function, inverse trigonometric functions, logarithmic functions. Different procedures of integration, namely, integrations by parts, by substitutions by partial fraction are also there. Then comes the section of definite integral. It includes definite integral as the limit of sum, statement of fundamental theorem and its application to evaluate definite integral. Interpretation of definite integral as an area and its related problems are also included.

The other group of this paper contains co-ordinate geometry of two dimension. In the beginning, there are preliminary conception of cartesian co-ordinate in a plane distance formula section ration, areas of a triangle etc. A detailed study on straight line, circle, parabola, hyperbola and ellipse is included in the course. The last chapter focuses on polar coordinates. Here the students are to study relation between polar and cartesian co-ordinates, equation of straight line and circle in polar form.

The purpose of putting calculus with analytic geometry has a definite meaning. Calculus did not spring

just to fill a vacuum. Rather it grew as it was needed to solve problems in geometry, physics and other 'practical' fields. The basic ideas of calculus are but expressed in geometric language and the learners can understand it better when they are taught this language. Once they master the geometry of the situation, they can easily tackle the deductive proofs of the theorems encountered in calculus. From the modern point of view, calculus should be developed by first setting down a few axioms and then constructing, in a sequence of logical steps, the entire structure of the topic. But definitely this approach cannot be practical at plus two stage, the reason of which is already stated. So, it is desired that the learners at this stage should get a clear geometric picture of what calculus is all about. Once the concepts and proofs of the theorems are clear, the student acquire a fluency in the language of calculus. If the learners at plus two stage gain the geometric insight and technical fluency, they will be ready to go on to a deeper study of calculus or to apply it to other subjects whenever necessary at their later stage of study.

The third paper consists of vector and mechanics. In vector, only elementary ideas and concepts are introduced through the study of meaning of the term, the algebra

of vectors like addition and subtraction of vectors product of two vectors. Mechanics is one of the important branch of mathematics today. Here, the first unit deal with particle dynamics and the second unit deals with statics. In dynamics the acceleration etc. are there. A detailed study of rectilinear motion is prescribed. Here, the vertical motion under gravity and motion in an inclined plane is also included. The next chapter in dynamics deals with work, power and energy. Here, the principles of conservation of energy and work energy equation is to be studied in a nutshell.

In statics, there are fundamental principles of statics, concurrent, coplaner forces, parallel forces. Above mentioned things are to study in detail: their compositions, resultants, and problems relating to these are also included. A thorough study of moment of a force about a point and couple in a plane is prescribed in the syllabus.

It is a fact that the entire content of the third paper is mere a repetition. Because almost all the topics prescribed in this paper are also there in physics. With little care and compromise, this duplication can safely be avoided and some important needed topics can be put in the curriculum. This will help our students a lot.

One of the lacunas of the prevailing syllabus is that, the solid geometry has remained unincorporated. It has led the syllabus to be incomplete. Without a clear concept about three dimensional plane, the concept of vector can hardly be perfect. The idea of three dimension is very much needed in learning mechanics too. So it is felt necessary to include the introductory lessons of three dimensional geometry in the plus two mathematics syllabus.

### 3.3. Comparison of National Board's Syllabi with NEHU Syllabus

A comparative study between the standard plus two curriculum followed at national level and the prevailing +2 curriculum in the State of Meghalaya reveals that:

(1) In Algebra, the first unit of national board's syllabus deals with a detailed study of number system. In real number system there are statements of algebraic properties of the natural numbers, integers, rational and real numbers and basic deduction from these. These topics are not taught systematically to our students, though they are to use them very frequently. Some important results, namely rational numbers as terminating decimal, or as non-terminating recurring decimal, inadequacy of rationals, irrational numbers as non-terminating and non-

recurring decimals can be included at least for information's sake. Representation of real numbers in number line, their absolute values included at national level syllabi have not been included in the +2 syllabus of Meghalaya. Nowhere attempt has been made to give a clear conception about real numbers which is very much necessary in the study of various topics in the subsequent stage.

The topics in algebra where there are no differences between the two curricula compared are principle of mathematical induction, the complex numbers, quadratic equations and expression (a detailed study), determinants upto third order, permutation and combination, Binomial theorem and Progression. In the chapter binomial theorem both the curricula suggests the study of a positive integral index with its statement, proof, and application and in the case of negative and fractional index only statement as well as the applications. In the chapter of progression, the +2 syllabus of the state include harmonic progression and the inequality involving A.M., G.M., and H.M. along with A.P. and G.P. which are not included in the national syllabus. The chapter on functions and their graphs included in both the syllabi, is not dealt in an elegant way. This chapter requires lot of efforts for building up proper concepts.

(2) National board syllabus on trigonometry varies from NEHU syllabus in the following aspects: Firstly, the national board syllabus includes periodicity and graphs of functions which are excluded in NEHU syllabus. Secondly, in Meghalaya +2 syllabus contains some topics like the inverse trigonometrical functions, summation of sine and cosine series (where angles are in A.P.) which are not there in the national board syllabi.

(3) Coming to the co-ordinate geometry of two dimension, Meghalaya's syllabus emphasizes on the detailed study of many more things which are not included in national board's syllabus like parabola, hyperbola ellipse and polar equations. National board syllabus includes family of lines and family of circles which are not there in Meghalaya's one. It is also suggested the study of parametric equations of circles and parabola which are excluded from the former one. In vector portion, the two syllabi do not differ significantly.

(4) Differential calculus of national board's syllabus contains illustration of Rolle's theorem, Lagrange's mean value theorem with its geometrical interpretations; primitive of functions and their calculations in simple cases. These are not included in Meghalaya's +2 curriculum. The rest of the things in both the syllabi are same.

(5) In integral calculus also there exists no significant difference between two syllabi.

(6) In addition to all these mentioned above national board's curriculum for mathematics includes few simple cases of differential equations, a good deal of matrices, solid geometry and probability and statistics. These are not there in Meghalaya syllabus. On the other hand, Meghalaya's syllabus includes a fairly large portion of statics and dynamics which are excluded from national board's syllabus.

Thus a close look to the comparative study of these two syllabi reveals the fact that Meghalaya's syllabus is lagging far behind the national board's one. This is one of the important reasons why the students of this state cannot prove their ability in the entrance examination of various professional fields after completing the plus two stage. It may be, of course, due to the low standard syllabus followed in the H.S.L.C. examination here, in the Meghalaya Board of Secondary Education. If the syllabus at plus two stage is framed at par the national level, a big jump will creep in and this lead to a chaotic condition for the students specially those who are mathematically backward. It will make most of the tribal students more confused especially when their mathematical base is not

strong enough. In presenting a fat and strong curriculum to the students of Meghalaya one must keep in mind their ability and all other constraints effecting their study. So the inclusion of some topics may not be a successful step just to raise the standard of existing syllabus. Mere inclusion of certain topics cannot improve the condition prevailing at present in teaching-learning process of mathematics.

The teachers of Mathematics in the State feel that there is no scope for inclusion of any topic in algebra, trigonometry and co-ordinate geometry at present. The same is said about the differential and integral calculus and vector. Because, these branches of mathematics is widely used in various technical fields, other science subjects humanities and life sciences etc. Inclusion of statics and dynamics also is fully justified not only because of these are used in physics and engineering sciences, but also because the topics in mechanics help in developing mathematical and logical thinking ability among the student. Moreover these topics provides with scope of correlating the knowledge of mathematics with other subject of the existing curriculum, namely physics.

However, a few topics in solid geometry and statistics could have been introduced in the existing syllabus.

Importance of solid geometry is already discussed. Statistics and Probability is taught as a separate subject, but the subject is not offered in all colleges. Because of its enormous application today in different subjects like economics, psychology, education, commerce, biological sciences etc. statistical literacy has become an urgent need in recent years. So, at plus two level, the introduction of the subject will help the students. Of course, statistics and probability together with matrices and some other difficult topics of mathematics is offered in additional mathematics course which is, no doubt, much more advanced than mathematics course. And it is offered by a handful students in some colleges. Since the percentage of intake of students in this course is rather very low, it has not served the purpose of broadening mathematical outlook in general.

#### 3.4. **The +2 Curriculum and its Continuity with that of Secondary Stage**

But the fact remains is that the introduction of many topics is not possible due to the very important reason, namely the wide gap between the syllabus of HSLC examination of Meghalaya Board and the syllabus for plus two level of the State. Continuity of the syllabus at different stage is very important for steady progress in the subject. The philosophy behind framing of the curriculum at secondary

stage is to provide some mathematical literacy to the students for whom the study of mathematics will be terminal so that they can use the knowledge in their day to day life. The aim is also to help those who will continue their study with mathematics in higher classes. But the present content in the HSLC syllabus for mathematics seems to be selected in such a manner as if the majority of the students will end their study at secondary stage. Although the day to day life situation was kept in mind in selecting the content, but it was done long back. The most of the contents is now out-moded. Only the topics on commercial arithmetics in the present syllabus at secondary stage seem to be somewhat meaningful. Whereas, the present secondary syllabus of any other State covers a good deal of geometry, mensuration, algebra and commercial mathematics. And the approach is algebraic and integrated. Arithmetics are covered under the envelope of algebra. Additionally, quadratic equations, linear equations, simultaneous linear equations and inequations, sets and mappings, operations of sets, number system, laws of indices, factorisation etc. are covered at secondary stage itself. In order to make the mathematics education at secondary stage more relevant and of international perspective, secondary boards at various states and the centre has included in their syllabi the study of logarithm, bank deposit, instalment and payment, share and dividend along

with the chapters on ratio and proportion, compound interest, percentage, profit and loss etc. Besides, those curricula also suggest the study of trigonometry and elementary statistics. The syllabus on statistics includes collection and presentation of data, frequency distribution, bar charts, frequency polygon, histograms and ogives; mean of raw data and ungrouped data. Thus the national board has been able to raise the standard at +2 level by introducing many new topics. The knowledge of basic concepts gained in secondary level forms a good base of understanding for the study of mathematics at higher secondary level.

At present the mathematics curriculum under Meghalaya Secondary Board suggests the study of Algebra, Arithmetic and Geometry. Arithmetic covers the chapters on factors and prime number, HCF & LCM, square root of integers; mensuration, unitary method, percentage, simple interest, problems on time and distance, time and work etc., ratio & proportion and average value. In commercial arithmetic, this board suggests the study of profit & loss and allegation and partnership. The students of MBOSE are required to study in algebra the following: use of algebra, simple formula and their application, simple equation, harder multiplication and division, factorisation, simple identities, HCF and LCM of algebraic expressions, simple fraction

and simultaneous equation. From this, it is clear that the board is still continuing the curriculum introduced nearly four decades ago with the idea that the common pupil who will discontinue the study of this subject after HSLC shall not use mathematics except these tit-bits. Practically, it does not prepare a student to study with mathematics in his higher classes. It has created the mathematical backwardness in the state. On the top of all, the persons manning the primary, middle and secondary stage mathematics in the state do not have adequate mathematical knowledge or background. This may be another reason for not introducing new topics in the school curriculum of mathematics. Thus, unless the whole system is improved or changed, the improved curriculum in mathematics seems to be difficult to introduce. Normally, the class of students and the class of teachers are not mentally prepared for the change of the prevailing syllabus although they know the inadequacy of it. But the fact that it has been causing a significant gap in their future course of study has not been realized, nor has it been explained meaningfully. As a result, when the students come to plus two level, they lack in the requisite knowledge of mathematics to cope with the plus two mathematics. Rather, most of the students find it more difficult to adjust. This is a reason why maximum number of students goes for softer courses leaving aside mathematics at college level. Thus, a situation has been prevailing

due to which it has not been possible to develop a comprehensive frame of curriculum within which the needs of region could be examined and corrective measures could be adopted accordingly. The existing university has also been working at its own level without much interaction with the school system.

### 3.5. Optimization of the Discontinuity of Curricula at Different Level

Though this disparity between the syllabi of secondary level and plus two level appears to be vast, it can be optimized to a great extent with some care. The students who need training in the basic mathematics can be given a remedial course at the point of entry into plus two level or after. This course may not be compulsory. It should be for those who want to continue their study with mathematics. It is true that remedial course which would be of short duration cannot be a permanent solution, but surely it would function as a catalytic agent till such time mathematics curriculum development at the school and college level are made in synchronization. Such an attempt will only work to bridge the gulf separating the plus two mathematics from school mathematics at present. Incidentally, neither the University nor the colleges have made an attempt to provide such remedial course for students. The education department of the state is also silent in this respect.

It is proposed in the NEC Project<sup>4</sup> by Dev Sharma to introduce such a course so as to bridge the present gap and also to fulfill the needs. But upto now no such positive step has been taken by any organisation.

### 3.6. A New Concept of Curriculum Development

Curriculum development involves a new concept which indicates that mind should first be trained to handle knowledge. The curriculum should be so arranged as to provide for continuous development of the learners with minimum strain and tension. Also, it should be so organized that there is a reasonable likelihood of successful learning.<sup>5</sup>

It is a fact that the course content at plus two level of this university is rather inadequate. But there is scope for its betterment. Since, the improvement of the curriculum should not necessarily imply the introduction of a completely revolutionary syllabus. Moreover, teaching of a subject, particularly mathematics, should serve the needs of the society and the people of the State. A report published by NCERT says that in Gujrat, before introducing the new syllabus in state wide scale, a project on modern mathematics-syllabus was launched in trial basis in some sixty educational institutions and the content of the syllabus were modified according to the suggestions from the teachers actually using the trial version.<sup>6</sup> Similar steps have been launched by Kishore Bharati in Madhya Pradesh for science teaching.

Such experimental projects can be launched in the state of Meghalaya before introducing a new syllabus. Meanwhile the draft of the proposed new syllabus could be distributed among the agencies concerned for opinions and suggestions.<sup>7</sup> It will establish a congenial atmosphere for the change among the students, teachers and the community as a whole.

### 3.7. Drawbacks of the Present Plus Two Curriculum

Present curriculum of mathematics at plus two level has got various drawbacks. First of all, it is non-flexible, rather too rigid and it does not provide the students freedom to learn.

No doubt, there are some disadvantages of a flexible curriculum. It is said that flexible curriculum may not be a reality, particularly in this state. Because, in a classroom teaching it is not possible to assess individual aptitude and differences. Also flexibility does not mean the absence of a well-ordered system. Some minimum standards of attainment must be specified. Along with this there must be some freedom for the teacher and the learner to choose their subject matter in the light of learning situation, in the absence of which the learning system becomes meaningless. There are only two alternatives for the curriculum to make it meaningful for all; namely,

either the selection and organization of the content has to be perfect or some freedom of selection and arrangement should be given to the teacher. Students must also have option in selection of topics for study. The curriculum which is mere collection of some topics and is not attached to the necessities, aptitude and abilities of the learners can be improved to some extent by making it more flexible.<sup>8</sup>

Another drawback of the present plus two curriculum in mathematics is that it lacks in correlation of mathematics with other branches of science and social sciences. It does not even correlate different branches of mathematics. No subject is complete by itself. The knowledge of one subject is important in a manner that it has bearing on the other subjects. So far as mathematics is concerned, it is used in various fields and in many branches of science today. The knowledge of mathematics is so important in this era that education as a whole remains incomplete without the use of mathematics. But it is really surprising to note that mathematics here is taught as a subject compartmentalised into itself. Therefore, the present syllabus should be modified to stress on correlation among different branches of mathematics within and outside. As far as possible connected topics of different subjects

should also be mentioned in the syllabus. Sometimes other subject serves as a source for supplying exercises and problems in mathematics. To facilitate correlation, the curriculum should mention the related topics of other subjects along with the topics of mathematics for gradation of exercises in the texts. To ignore the application and uses of mathematical knowledge means to ignore the very purpose of mathematics education. The best result can be achieved only when the various topics of mathematics are taught as the constituents of an integrated course. There may, of course, be some difficulties in implementation of this. Because, the development of an integrated curriculum on modern spirit can be undertaken only when the teachers are first exposed to it.<sup>9</sup>

One of the major defects of the present curriculum is that there is no separate provision for the gifted, and the slow learners. The curriculum has been made primarily for average learners.<sup>10</sup> The textual materials dealing with the subject matter are also more suitable for the average learners. It is not to be forgotten that one of the most important resources of the state is the gifted class of students. The state is already in dearth of technical manpower. In addition to this, if the gifted, talented class are not uplifted to a desired

level, the state suffers. The State is not lacking in human and intellectual ability. But it is lacking in the effort to identify and nurture the best of the talents. These brighter students must be provided with appropriate learning and working facilities. The syllabus should provide them with some suitable units illustrating the modern application of mathematical topics and in different areas of life. They may be encouraged for indepth study of the topics meant for them. Also special curriculum with advance courses may be given to them at the separate classes, if possible. here in the state of Meghalaya the colleges offer an additional mathematics course at plus two stage. It is an optional course. Yet there is no scope for selecting the talented students from this course due to the lack of institutional facilities. The number of students opting this course is rather negligible compared to the need. Thus it has not been helping much in catering to the interests, curiosity and mathematical quality of the students.

Truly speaking, nearly 80 to 90 percent pupils are scared of studying mathematics. They are either in the class of the students who are mathematically backward or in the slow learner group. The present system does not help in diagnosing them, at least the slow learners. It is

impossible to make different curriculum for different types of individuals. But it does not mean that these groups are to be neglected. The curriculum should meet the need of every learner.<sup>11</sup>

The present syllabus followed in the colleges of Meghalaya is not at all elaborately spelled out. The teachers are expected to decide the details of the topics in his own way. An individual teacher normally takes help of the textbook followed by him and so the teaching standard varies from college to college. Moreover it does not indicate anything about the techniques of teaching. As a result the uniformity in teaching mathematics has not been attained. Ideally the syllabus should be more precise. That is, in addition to listing the topics, it may indicate the way in which a topic has to be developed at a given level. That would help a teacher to introduce the concept with proper motivation.<sup>12</sup>

Topics are not at all sequentially listed in the present curriculum in the state. It seems to be a catalogue of topics. So it has not helped to unify the mathematical thinking process. Besides, there is no indication in the syllabus as regard to make use of all unifying language and symbolism throughout the course. This results in the need for reformation of curriculum as a continuous process.<sup>13</sup>

The present curricula in mathematics in the state of Meghalay is mostly examination oriented. The examination is conducted externally. So what is taught in the classroom is mostly controlled by the will of the external paper setter. The teacher is thus compelled to teach those so called 'important' topics with great emphasis and the students are also to prepare them. As a result the teaching has lacked the concept building approach. There is no freedom to teach for the teacher and freedom to learn for the learner in the present system.

Also there is no provision for extra- and co-curricular activity in the present mathematics curriculum at plus two level prevailing here in Meghalaya. This has led the students to think that there is nothing interesting in mathematics except some questions and answers to mug up. They do not find creativity, interest and amusement in the study of their course. The teaching methodology is also done in such a way that it has not been able to induce the above mentioned attributes of mathematics teaching which are said to be aims of teaching mathematics today.

### 3.8. Conclusion

Mathematics as it is taught today in the state of Meghalaya appears to be a fragmental collection of facts,

techniques and theorems which bear little or no relation to each other. To help the learner to understand the motivation of learning mathematics, integration of mathematics with life experiences should be encouraged.<sup>14</sup> The curriculum should also integrate mathematics within itself.<sup>15</sup> The course should not merely be listing of topics but should indicate the way in which a topic is to be introduced and how far is to be developed at each stage.<sup>16</sup> One of the basic objectives of teaching mathematics today is to enable the students to learn the basic structure of mathematics through unifying concept and to motivate these structure through application and concrete situation.<sup>17</sup> In order to achieve this objective the prevailing curriculum has to be developed both in content and methods. It should not be designed only from standpoint of mathematics but has a linkage with the society and the teacher and learner of mathematics.

One must find a suitable answer in it if asked 'what is the place of mathematics in the society of Meghalaya?' And 'what mathematics content and pedagogy would best accommodate the social life in the State?'<sup>18</sup>

### 3.9. **Factors to be Considered in Mathematics Curricular Reforms**

In any new curricular designed cultural and psychological learning trades together with the applica-

bility must be taken into account. Before planning anything into the curriculum it must be ascertained whether the proposed programme will be meaningful to them for whom the curriculum is meant. This is not a question concerning 'intelligence', for in a cross cultural situation, the word 'intelligence' has little meaning but rather its focus is mental priorities and preferred modes of thinking. The mathematician cum psychologist, Scamp,<sup>19</sup> notes that concept attainment is a function of cultural heritage. In framing a new curricula at plus two level in the traditional societies like that of Meghalaya, the process of formal logical construction and the conceptualisation of mathematical operation diverge from western norms. The framers of the syllabi must wonder how much the local students will benefit from the programme whose very foundation are incompatible with their trends of characteristic thinking.<sup>20</sup> It is a fact that little has been done so far to do research into the psychological foundation of mathematics learning among the tribal people of north east region. In order to frame a meaningful curriculum in mathematics, psychologists, anthropologists, and mathematics educators must work together and strive to obtain an understanding of the thinking processes of the people they hope to assist.<sup>21</sup>

It is also important that the economic realities along with the social needs be reflected in curricular decision. To quote it may be said the western mathematics and science curricular reforms have evolved in a large part from the technological demand of highly industrialized societies. Naturally such demands are lacking in a state like Meghalaya, whose present social and economic structure is determined by an agricultural subservience and is not likely to change radically. Here the school mathematics instruction must also be cognizant of this fact. The emphasize of 'word problems' in mathematics should motivate the students' interest in societal goal.<sup>22</sup> Because students steep solely on theoretical aspects of mathematics often find themselves alienated from the realities of their world.<sup>23</sup> Consequently, instead of leading in the tasks of nation building, the educated people find themselves as spectators in the movements of change. They become frustrated in their inability to incorporate their knowledge with meaningful social activities, specially those who leave their studies at the end of HSLC examination or at plus two standard.<sup>24</sup>

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CHAPTER - IV  
MODERN TEACHING-LEARNING SYSTEM: VIEWS OF THE  
TEACHERS AND THE STUDENTS

## MODERN TEACHING-LEARNING SYSTEM: VIEWS OF THE TEACHERS AND THE STUDENTS

### 4.1. Purpose of Questionnaire

From times immemorial man has learnt many things and also has taught many things to others. In ancient times, the teachers (known as Gurus) taught their students (known as the disciples) in 'Asrama'. Those were the days when there were no printing press, no printed books and even no exercise books. The teachers used to teach their students orally. On the other hand, the students also received the teachings whole heartedly, with a view to grow up to be a perfect man in the real sense of the term. But with the expanding horizon in every direction, right from the population to the frontier of knowledge, there arose a need of formalising the techniques of teaching-learning along with the growth of formal civilisation. So, without knowing the art of teaching, a teacher cannot train his students to be a perfect man. It is through the art of teaching alone that man is able to call himself civilised and cultured. Now a days, the art of teaching has developed to a great extent. It has branched out into two direction, namely (1) Principles of teaching, and (2) Method of teaching.<sup>1</sup>

On the other hand, learning is also bound by some principles based on methodological thinking and research. It is highly desirable that all teachers should possess certain insights into the nature and conditions of learning which will help them to modify their teaching process and subsequently improve them.<sup>2</sup>

Learning is essentially an active process. Because the learner is impelled to action. He learns through listening, speaking, writing, reading, thinking and also acting. A real passive student can be considered as a mere spectator who may be called, a no-participant in the learning process. And this set of passive students can hardly be taught by usual teaching process.<sup>3</sup>

That is why education is rightly called a bipolar process.<sup>4</sup> It has two important parts - one is the student and the other is the teacher. The success of any educational system much depends upon the better performance of this two-way process - teaching-learning activities. This is very much true in case of mathematics teaching also. A mathematics teacher has also to abide by certain principles while teaching. He has to associate himself with the students in one way or the other. He has also to know the problems of the students and accordingly remove those. He has to ensure through such methods as

he thinks necessary that the student has learned the lesson he teaches. In fact, all the ways and means by which the student learns and imbibes lessons, taught by the teachers comes in the purview of the techniques of teaching. The success of teaching mathematics very much depends upon the techniques adopted by the teachers. Thus, teachers as well as the student form the important part in the teaching-learning process. However, success depends directly on the teacher, because the responsibility of teaching lies entirely on him. So far as teaching of mathematics is concerned, it is the teacher who can make the teaching of mathematics meaningful by the help of his knowledge, and interest for the subject and also by his love for his pupils. The learning of mathematics will be easy and enjoyable if teaching is clear, purposeful and systematic.

So, the impact of merits and demerits, advantages and disadvantages, success and failure of the teaching-learning system falls primarily on these two classes viz. the teacher and the taught. An investigation on present status of the educative system, without the opinions of these two classes cannot be regarded as a complete one. In order to ascertain the prevailing conditions of teaching-learning of plus two mathematics, the

students and teachers are desired to be interviewed. This task of interviewing the students become easier with the help of a common questionnaire. The questions that is to be asked to the students can be prepared before hand which is distributed among a group of selected students. This process of interviewing saves time and energy of both the students and interviewer. Moreover, some students who are shy to answer openly can freely discuss their views in a questionnaire

Teachers can also be interviewed by this method. But the limitation of a questionnaire is that it cannot provide scope for open discussion about all sides of the teaching-learning process. An experienced teacher can inform much more about this matter than just he is asked to furnish.

In the present investigation a group of plus two mathematics students from all colleges of Shillong was interviewed with the help of a questionnaire.<sup>5</sup>

Another questionnaire<sup>6</sup> was employed to obtain the views of the mathematics teachers of plus two level, and for this purpose a group of mathematics teacher were selected where all colleges of Shillong was represented. These teachers also personally interviewed for a free

and detailed discussion on present mathematics education of the state.

#### 4.2. Views Expressed by the Teachers

All the teachers were served the questionnaire put in the Appendix. VI. Apart from that most of them were personally interviewed and the following observations are made on the strength of the interview and the replies collected through the questionnaire.

A. Most of the teachers feel that the existing syllabus followed at plus two level in Meghalaya is not upto the mark. In putting this remark, they seem to compare the syllabi of CBSE and ICSE in particular. Although a few chapters from modern mathematics seemed to be introduced in the syllabus, it lacks the present need of the students to compete in the competitive examinations to enter in various vocational courses after plus two stage.

The teachers were asked the reason for this lacuna because there is a board of undergraduate study as well as a P.U. Board under the university which can throw light on it and make requisite modifications. In response to this question, it is expressed that the main constraint in this direction is the static curriculum followed by

the Board of Secondary Education, Meghalaya (MBOSE) for long years. Unless the syllabi at secondary level is changed it is not possible at all to change the plus two syllabus upto desirable extent because curricula at different stages is a continuous process.<sup>7</sup> Curriculum should include the contemporary material, that is, the courses of the study, by which the learner can attain a requisite knowledge to fit himself into the next stage, so the material of the curriculum should be taken from the consideration of the relevance and need of the learner at the first instance, and of the society at the next. That is why, Dr. Atmanand Misra, an eminent educationist, says, "In curriculum we find a collected treasure of the experience of man". Man's civilisation is reflected in curriculum studied. Cunningham remarks about curriculum which reveals that,

- I. Curriculum is the main mean of education.
- II. Teaching can be possible by curriculum.
- III. It prescribes the time schedule.
- IV. It prescribes the standard of teaching and learning.
- V. It assists in reaching the goal, and
- VI. It makes teaching easy.

From these points of view, we can easily remark that the mathematics syllabus followed in plus two

curriculum in Meghalaya is completely inadequate. This is apparently reflected by very low input in various professional courses from the class of students, completing their plus two stages in Meghalaya.

The negligible amount of students are getting admitted into the technical courses and the teachers interviewed feel that this is due to the inadequate standard of mathematics syllabus taught at plus two stages.

Apparently all teachers seem to be of the same opinion that the content of the present syllabus followed at plus two level are not upto the mark and as such it does not reflect a link with the higher growth of mathematics. In fact, as described in the chapter one, there has been a continuing development of mathematics education as a whole, over the last two decade. The impact of such development has come in a big way in many parts of the country but in Meghalaya, it has not penetrated to a desirable extent. The main reason of such lacuna is due to the fact that the school mathematics curriculum as pointed out in the above paragraph is still a long way back. The so called modern mathematics and its consequences have not been carried out in school mathematics curriculum. As a result, the curriculum at plus two level has suffered a lot. Although at the graduate level in the university,

many modern topic has been inducted, its impact cannot be judged from the curriculum followed at plus two stage. The present curriculum at plus two stage seem to become a collection of few topics needed for passing out exams and to enter into some competitions, though inadequately. On numerous occasions recommendations have been made for the improvement of mathematics education, but hardly they are implemented in Meghalaya.

It is a fact that many new branches of mathematics and its major application have been created or largely developed during the century. A few of these are kept in the graduate and post graduate syllabi of the University but there has not been made a link of these with the syllabus at plus two level.

It has been observed from the results of various examinations, specially in professional and vocational lines our students passing plus two stage fail either to be accommodated or to cope up with any profession functionally because of their inadequate knowledge in mathematics. It is often common for a plus two student who is interested in science but could not have proper mathematics background to go even into biology, because the present courses in biology requires quite a bit of physics and chemistry while physics and chemistry are requiring

more and more mathematics. Furthermore, Biometrics, the most new branch of Biology, uses mathematics extensively. So our teacher community strongly feels that the syllabus of mathematics at plus two level should be improved to such extent that the students crossing out this stage are not confrontive to pursue any course, whatsoever professional or general due to the lack of adequate knowledge of mathematics. For this, an expert committee is suggested to be set up to study at length the lacunas in the present syllabus. For example, the committee may consider to find out the gaps of this syllabus with that of undergraduates and other professional courses and also to have a consideration of improving school mathematics syllabus in this context. The committee may also chalk out the various topics to be inducted at the plus two stage. Furthermore, the committee may suggest the ways and means to implement the improved syllabi at plus two level. The P.U. Board, which is set up for the purpose of looking into the affair of plus two educational system under the University, should be impressed upon the recommendation of the committee and it should be ascertained that the suggested remedies are implemented meaningfully.

In order to improve the qualitative aspect of mathematics curricula at plus two level, the teachers

interviewed expressed the following view in order to provide direction to the future work in mathematics education in Meghalaya.

1. The content of the syllabus needs to be updated keeping in view two things: (i) the basic requirements of the students at this stage which are relevant in their higher studies, and (ii) the general standard of the students opting mathematical sciences. However, it is expressed that there should not be too much sacrifice in the standard of mathematics while caring for the standard of the local students.

2. In order to accelerate the receptivity of the ideas etc. in mathematics of the local students, the teaching methodologies must be changed, so that individual attention can be paid. The introduction of special remedial courses for weaker class in mathematics is recommended. Although in some colleges there are arrangements for tutorial classes, it seems that such arrangements has not served the purpose to a desired extent.

3. It is desired that the recommendation of Kothari Commission, Patel Committee, on mathematics curriculum and also the NCERT documents on school pattern should be duly considered while framing the mathematics syllabus

at plus two level. There should be a general core course for all without any distinction, and then some special topics for diversification. Such topics may be of supplementary type, exhibiting application of different key concepts to a variety of areas which the learner may encounter after plus two stage.

4. The present syllabus seems to contain many unnecessary topics which can be replaced by topics from the 'utilitarian' point of view.

5. There are few chapters which are duplicated in physics and chemistry. This duplication can safely be avoided and the concepts included for their utility in these subjects need to be examined for the methodology. There should be one approach at plus two level for a particular concept whether it is taught in mathematics or in physics or in chemistry.

6. The approach to differential calculus as well as integral calculus should be intuitive and empirical. This will mean to maintain international standard of the topics. It is felt that only some elementary ideas in these topics are enough at this stage.

7. While teaching mathematics stress should be laid in acquiring the computational skills and thinking

processes. Additional creative attitude should be encouraged through the application of the ideas.

8. It is earnestly felt that there should be a source book for the teacher, where specific suggestion in every topic of the syllabus are there as regards to how to teach, when to teach, and what to teach.

B. Regarding the acceptance of mathematics education as a whole by the students at plus two level the following observations were made by the teachers interviewed.

1. In general, students are success oriented. In other words, they care more to score marks in the exam than acquiring knowledge in the subject taught. As a result, they pay more attention to those topics from where questions are frequently set. This has led them to be mechanical in receiving mathematical knowledge.

2. The tribal students opting for mathematics do not seem to be quite enthusiastic for the subject.\* They inherent fear psychosis which seem to confront them in accepting mathematics in the right spirit.

3. Because of the reasons put forward in (1) & (2) the general acceptance of the students at plus two stage

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\* Vide Table - 8, Appendix IV




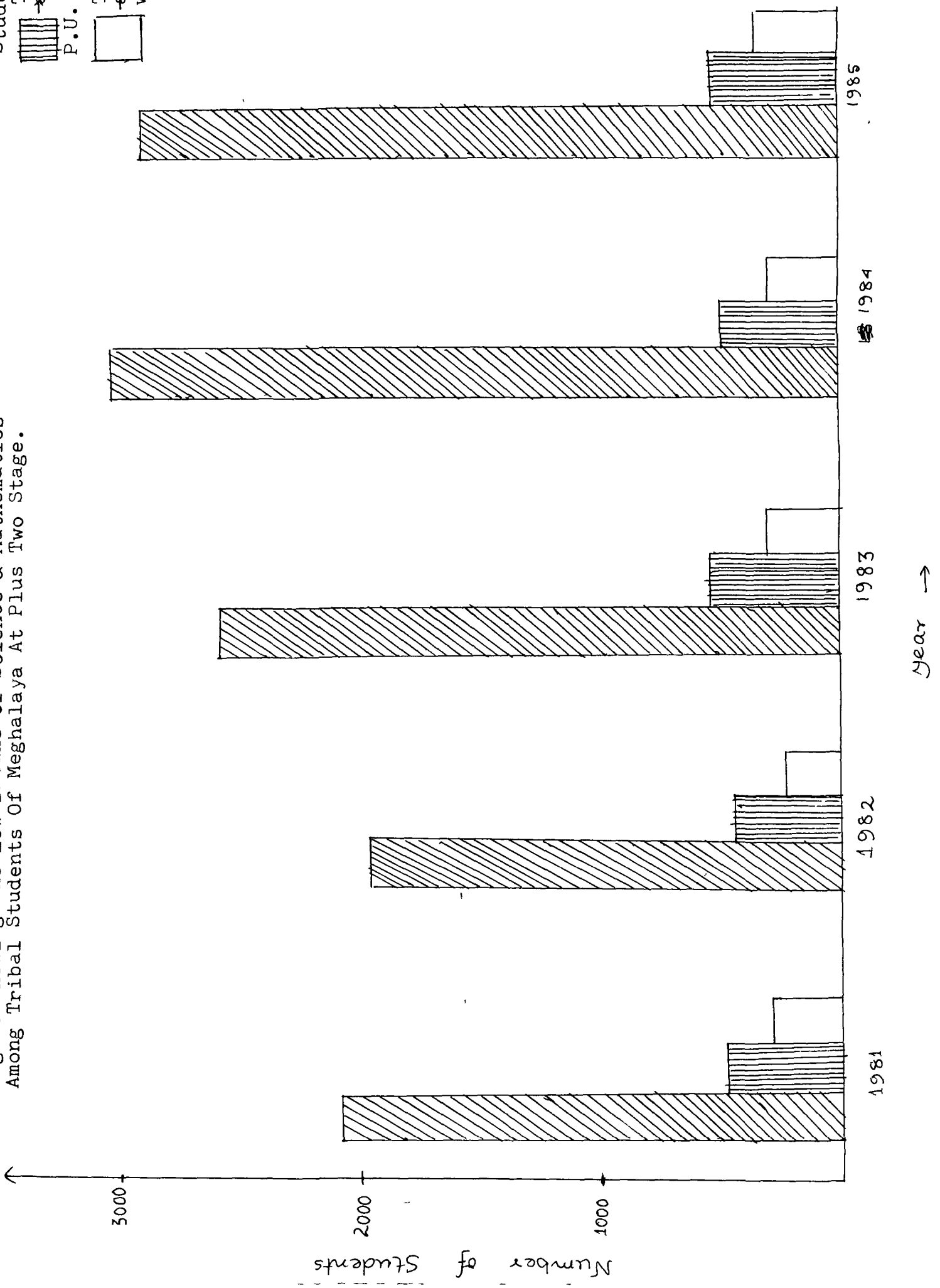
 T.C. T<sub>1</sub>  
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 T<sub>2</sub>  
 P.U. S  
 T<sub>3</sub> W.

FIGURE 4

Figure Showing The Low Intake Of Science & Mathematics Among Tribal Students Of Meghalaya At Plus Two Stage.



is not congenial in order to pursue mathematical or mathematics based subjects in the next stage.

3. Most of the teachers interviewed feel that mathematics teaching at +2 level in Meghalaya is not properly handed due to various reasons.

Firstly, it is because of the poor acceptance of mathematics by the students in particular.

The general attitude of the students has pressurised the teaching community to teach the subject from the examination point of view.

Secondly, there is lack of planning for the class. Hardly any teacher cares for the formal lesson plans or unit plans are as a result of which the spontaneity of the teaching the subject gets lost. It is often said that the continuous and vital job of planning for teaching places heavy demands upon the classroom teacher because many dimensions of the teacher's background experience and knowledge are called into play during this process. The effective planning of a subject or a unit helps the teachers to reveal significant knowledge, perspective of the subject to be taught, perspective understanding of the topic taught, apart from exhibiting the teachers organising capabilities through planning,

evaluation of the teaching, learning activity can be well judged.

Thirdly, there is lack of uniformity in teaching pattern. Since plus two stage in Meghalaya is still coupled with college system of education and the college teachers mostly untrained (i.e. without having any training diplomas etc.), the teaching methodology has become mostly individual. Had it been with school system, most of the teachers would have post graduate training (PGT) and consequently some uniformity in teaching could have been achieved. However, the teaching standard at present, existing in different colleges in Meghalaya seem to be not far from satisfactory. The group of teachers interviewed feels that, within the framework of present system it is not always possible to attend the students individually. In most of the colleges the student-teacher ratio is beyond the desired limit, additionally in many colleges, a teacher is to take too many classes, due to which, the teacher gets over-burdened. An over-burdened teacher can hardly manage an individualised teaching.

However, considering the need of the student, particularly the group of slow learner, the arrangement of tutorial class is there in some colleges. It is reported that such individualised attention has helped the slow learners to some extent.

C. The use of educational technology in teaching mathematics at +2 level has never been made. Every teacher interviewed, however, agrees that the same concepts can be better taught with the help of instructional material. It is generally opined that almost all the colleges in Meghalaya are underfed in respect of library facilities, not to speak of audio visual aid.

To suggest some of the aids other than the textbooks, the teachers interviewed refer to the need of procuring a TV Set with VCR together with some film and film strips on mathematical ideas relevant to +2 stage. They also suggest to display bulletin boards, mathematical models etc. revealing the mathematical concepts and facts. They also suggest the use of projectors, overhead and micro, occasionally to explain the mathematical facts, concepts, and terminologies. It would be really ideal to have an audio visual library where the students can have graphs of mathematical ideas displayed. The present commonly available media like radio and tape recorders can also be made available to the colleges so that at least once in a week or so students can listen to the mathematical programmes in order to achieve a general awareness in the subject.

D. The teachers are in view that the textbooks followed in almost all the colleges at plus 2 stage

in Meghalaya, are not specifically written for P.U. Courses of NEHU. Additionally, different books written by different authors are followed in different colleges although the books are selected from a list of books approved by the University. It is a fact that the approach of mathematics teaching is at the cross roads. The textbooks available in the market are found to be in two categories - some with the classical approaches and some with so called new approaches depending on set theoretic notion as well as algebraic approach. Specially, the books on calculus and trigonometry have shown significant differences in their approaches. Since there is no clear cut instructions from the syllabus committee the teachers are free to follow any approach he likes individually. Similarly, textbooks on mechanics are mixed with the classical approaches and vectorial treatment. Such dual approaches or methods not only confuse the instructors, but also create confusions in the minds of the learners. On the top of everything it has been observed that the textbook writers, in order to cover syllabi of more than one university, keep relatively additional topics to one particular university, board or council. It has made most of the textbooks unnecessarily voluminous.

Some of the textbooks followed in Meghalaya are not free from printing errors. Since there is no way out for a teacher than to rely on the textbook followed, it is highly desirable to have a full proved textbook to teach a topic. NEHU syllabus of mathematics at +2 stage is found to be different because of the very traditional curriculum followed at present at the school level. So the University as a whole should go for the preparing and producing the textbook specifically meant for NEHU syllabi. It will then help the teachers as well as the taughts to avoid the difficulties of choosing the right textbook for the right purpose. In doing so care should be taken to streamline the approaches to be followed at the time of instruction and learning. The most important point to be noted is to take into consideration the nature of the local needs and also the particular need of the mathematically slow learners of the state of Meghalaya with which the teacher are to work. The local production of the textbooks can only incorporate such needs.

#### 4.3 Views of the Students

At any stage of the teaching-learning situation the learners constitute one of the two vital elements. Rather, the learner's attitude and motivation are more

important than anything else in the teaching-learning process, because one of the factors deciding the meaningful teaching of mathematics is to know 'whom to teach'. The efficiency and accuracy with which a teacher performs his teaching in mathematics are reflected through the acceptance of the learners. So, in order to have a total picture of the status of mathematics education at +2 level in Meghalaya, more than 100 students selected at random from different colleges of Shillong, were personally interviewed for this purpose.

1. It is observed that students in general opting mathematics at +2 level find it somewhat easy to pass. But tribal students in particular are found to express their views that it is slightly difficult to adjust in the mathematics syllabus after passing out HSLC examination from MBOSE. However, the students passing ICSE examination, as well as CBSE examination, at ten plus stage find it relatively easier to adjust in the present syllabi of mathematics. According to these students, more than half of the courses are nothing but a repetition.

A class of better students expressed their feelings that the present mathematics curriculum followed at plus two stage do not fulfill the requirements of appearing various competitive examinations after that.

stage. As a result, many of them are either to go for extra coaching or to give up the idea of appearing competitive exams. Further they are of the opinion that quite a few topics kept in the syllabus are of traditional character, as a result, even after knowing those topics they fail to do well in the competitive examinations. Students in general feel that HSLC syllabus currently followed by MBOSE is sufficiently inadequate and so to start with the plus two stage mathematics a gap is felt. Although everybody feels that there is a gap, it is genuinely admitted that it is not a big jump. They can adjust after sometime to cope with the syllabus.

2. As regards to the teaching standard of mathematics, students have varied opinions, although the most of the students seem to be used to the general teaching patterns. The better group of students seem to have reservations about the teaching methodologies. The examinations oriented teaching do not seem to attract them. They want to have basics to be explained and questions to be put so that grasp of the topic taught may be reflected through their responses. They seem to expect their teachers to cover the type of teaching which can help them to catch up any professional course after finishing the plus two stage. According to this group, the future

of plus two mathematics should be such that it can link up the higher studies comprising mathematical uses as well as the technical education.

The general students seem to be satisfied with whatever they get just to manage the examination. However, this class of students express their view that the stereotype teaching of mathematics has caused to create a sense of disinterest among them. The teaching of mathematics, done only through the lecture method, does not attract them and as a result the students in general do not seem to be serious to the desired extent in the name of mathematics. They also express that the teaching of mathematics at +2 stage has failed to reflect the contemporary growth and development of mathematics around the globe. It is rightly reported that the teaching of mathematics at +2 stage in the colleges of Meghalaya has not been made meaningful as it should have been in this age of science and technology.

The so called backward class in mathematics, could not throw much light on the question of teaching standard of mathematics. This group of students seem to be quite reluctant to mathematics and many of them have admitted that mathematics has been chosen by them under pressure. Most of their guardians want them to

pursue mathematics with a hope of catching up a technical line after +2 stage. The mathematically backward group of students desires to be attended individually which is very much lacking in most of the colleges.

3. In response to question No.3, as regards to the teaching standard most of the students showed a mixed reaction. It seems they are a bit hesitant to express their opinion freely, frankly. However, through personal interviews it could be gathered that the students in general are not quite happy with the classroom teaching. To most of them the fast rate of teaching seem to create a sort of complexity and confusion to understand mathematics in a proper way. The time bound teaching of mathematics, that too with lecturing only does not seem to be sufficient for the general students. The tribal students except a very few, categorically express that the teaching standard in the classroom is not good enough in learning mathematics. Besides, it has not been able to motivate the learners to a desirable extent.

Whereas, a set of students expressed their views on the teaching standard of mathematics at +2 level to be satisfactory in the sense, that teachers are really helpless to accommodate each and every student in their class. Because firstly, the teachers want to cover the

prescribed syllabi. Secondly, the number of working days set for a session does not seem to be proportionately adequate. Thirdly, the low standard input towards the plus two stage from HSLC stage causes another hindrance in having the standardise teaching pattern.

4. Asked about their likings towards mathematics the reply found is quite affirmative. Most of the students have expressed that they like mathematics because it is the most interesting subject in their curriculum. They point out that mathematics has vital link with physics and chemistry. Additionally, they find mathematics to guide them to think logically and also to reason out successfully. A class of students points out the multifarious application of mathematics in every walk of life apart from its use in their studies.

But there is a class of students who admits that they have been forced to take mathematics by their guardians because they are wanted to join some technical branches after the completion of +2 stage. This class of students when asked specifically about their free choice they say that they do not have any bitter feelings about mathematics. However, they do not want to have it because of the fact that they find it difficult. And some students belonging to this category, but of

final year at +2 stage, when asked about their likings of mathematics, expressed that they are coping up with the subject with individualised help privately.

5. In fact, majority of the students are seemed to go for private tutions. As mentioned in the last lines of the previous paragraph the set of students forced by their guardians to opt for mathematics invariably goes for private tuition. The better class of students are also found to take help of private tution because of the following reasons.

1. As mentioned earlier, the classroom teaching being time bound does not help the brighter class to complete the course only through class teaching.
2. The syllabus followed at present at +2 stage at Meghalaya being of relatively low standard fails to help the brighter class to stand in the competition for the various competitive examination, to be taken after the +2 stage.
3. The general class teaching seems to be not enough for solving adequate number of problems needed by the students. Private tution helps them a lot to remove this defect of class teaching.
4. Additionally, the individualised care that can be had through private tutors helps the students to improve their standard.

5. Private tutition also helps to remove the silly mistakes and common errors often committed due to carelessness.

#### 4.4. Conclusion

It is a fact that students in general find mathematics teaching inadequate to serve their purposes whatsoever. Besides, to go for the tutions has become a sort of fashion among the students. A class of guardian seem to be proud of their wards sending for private tutition, without accounting for the net result to come out of such tutition. However, it can be admitted to be a fact that due to the number of constraints mentioned in this thesis have made the most of the students at +2 stage to opt for the private tutition, although in some cases such a tutoring becomes nothing but a miniature classroom. Yet, students join it in order to have a personal attention from the tutor to remove doubts in some basics and also to get number of problems to be solved. Normally, students in general are seemed to be motivated for the examination only. The so called 'important question' are wanted to be solved by the students and the system of private tutions does that. Although there is always a strong criticism about the system of tutoring, the system is always on: If the private tutition is to be really checked the authorities concerning the frame of curriculum,

the holding of examination, the setting of question must put their heads together to work out a well balanced plan so that the classroom teaching becomes adequate and beneficial to the desired extent. The system of teaching technology should be such that the class of student whether general or brighter does not feel the urge of going to the private tuition. For this, our teaching methodology if need be should also be reset. The task is of course not easy, and definitely it would be of challenging nature. The education department as well as the university must work out some innovative plan to user such changes into our educational system through creating proper strategies for it.

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CHAPTER - V  
REMEDY AND SUGGESTIONS FOR IMPROVING THE  
MATHEMATICS EDUCATION IN THE STATE

## REMEDY AND SUGGESTION FOR IMPROVING THE MATHEMATICS EDUCATION IN THE STATE

### 5.1. Introduction

The world we are living in is of accelerated changes produced, to a large extent, by science and application of technology. In such a world everybody is affected by and large due to the impact of science in human affairs. Science and technology have become an integral part of the world today. So one of the aims of modern education should be to help men to adjust to the changes<sup>1</sup> and to provide a grounding in the basic principles of science, which have stability even though the total content of science expands rapidly, and can help men to adjust to the changes of modern life in any state - in any part of the globe. On the other hand, the social and economic development of a state requires a climate of widespread and popular acceptance of science and modern technology. But modern technology requires manpower with fundamental training in basic science and also in mathematics, since mathematics is the key-tool for all sciences today. To make a significant step towards progress scientific literacy must be achieved and acceptance of science and technology must be widened more and more. The north eastern region being exceptionally backward in this regard should move at faster rate towards scientific as well as mathematical literacy. Because of the

lack of skilled technical manpower, the region is suffering in overall development. Although it is rich in natural resources the full potential of the region has not been utilized.<sup>2</sup> So the need for strengthening the mathematics and science education all throughout the educational system is imminent in view of severe constraint being experienced by the region. It is very much true in case of Meghalaya too.

#### 5.2. Various Problems: Dimensions

In order to make mathematics education living and meaningful in the state, it is required to identify the several aspects of the problem of mathematics education over the state, of which a detailed discussion were made in Chapter II.

Nobody can deny that the very basis of the whole mathematics education - process is the teaching system. The teaching system again consists of two wings viz. the teachers and the mode of teaching. In order to improve the educative system, attention should first be paid to remove the defects in the mathematics teaching system. Successful teaching of the discipline can be carried out only by a good mathematics teacher. It is the teacher who is responsible to a large extent for motivating the learners as well as for bettering the quality of

mathematics education at all levels. The persons manning the plus two level mathematics in this state are lacking adequate training and exposures that are required to meet the requirements of successful teacher. The minimum qualification to become a teacher at plus two level is a master's degree over the subject. But master's degree alone is not sufficient as it does not provide a person with good training in mathematics teaching. Now a days, it is insisted on having Ph.D. or M.Phil holder candidates. But even after Ph.D's, a person entering into teaching profession seems to lack the desired art of teaching, since he does not have any knowledge on methodologies of 'how to teach'.

#### **5.2.01. Teacher's Training**

In seeking to improve mathematics teaching we have to consider the need for special training for the teachers of mathematics. The overall goal of such training for mathematics teachers is to provide the teachers with appropriate knowledge, skill, attitude for teaching mathematics under changing curriculum and conditions. To attain this objective, teachers training programme can be arranged in two phases. The first phase known as Pre-Service Training should be meant for training teachers before entering service and the second phase for the teachers already employed.

(i) **Pre-Service Training**

At plus two level, a master's degree is essential for becoming a teacher. But at M.Sc. level one does not get any scope of being exposed to 'good mathematics atmosphere'. There is no sort of training to obtain a depth in mathematical knowledge. So the fresh lecturers are often uninspiring and they lack vigour and excitement. In principle, the level of the teacher's information should be much higher than that of the information he is expected to impart.<sup>3</sup> So a fair understanding of the broad field of mathematical analysis and reasoning should be a pre-requisite for becoming a mathematics teacher. Introduction of a system of recruiting teacher after an intensive training for about one or two years to make them upto date in new trend and development of mathematics as well as the modes and methods of teaching is desirable.

A teacher with an M.Sc. degree does not have broad base on the entire horizon of mathematics needed to teach. So to bridge the gap between the master's degree and requirements of a teacher, a post M.Sc. training is the only way. The first half of the training period may be given to widen their knowledge. Some advanced course coupled with the critical study of the courses

already covered at M.Sc. level may also be included in this programme. Since the students entered into such programme are desired to become professional mathematics teachers, in the second half of the training programme a course on the teaching of mathematics may be given. The students should also be exposed to historical aspects of development of some important concepts of mathematics and techniques of teaching mathematics through seminars. The last item of this training course may be supervised practice-teaching, at least of one hour's duration. A few demonstrations by experienced teachers will help the teacher trainees to know about the techniques of classroom management and effective teaching. The main object of this part of training is to offer suggestions for the improvement of teaching covering various aspects, such as, class preparation, teaching techniques, management and control, personal and professional qualities etc. Inclusion of various items of professional training always helps the trainee to acquire experience and also to gain self-confidence. Thus, practice teaching should mark the beginning of reflective and analytic thought in examining and solving teaching difficulties.<sup>4</sup>

Pre-service teacher training course should also include paper reading, project work, and preparation of teaching-learning materials and teaching aids. Such

schemes will help the trainees to be acquainted with new areas in mathematics. Suitable learning modules illustrating an integrated approach to content and methodology should also be prepared to help the trainees in this regard. Innovative teaching practices--such as team teaching, self-instructional materials, micro teaching etc. should be encouraged in the pre-service teacher training programme.<sup>5</sup>

(ii) **In-Service Training**

Mere pre-service training is not enough to meet the requirements of a revised upto date curriculum in Mathematics. The value and effectiveness in continuing the training of existing teachers to a higher place of efficiency and competence are widely recognised. In view of the massive character of the problems of training of existing teachers, an effort has to be made in a big way for inservice training. Such a training programme may comprise a number of items; namely, summer courses, workshops, seminars etc. These trainees should have the experience of trying-outs of materials in actual classroom during their period of training. For, in-service teacher training will give the teachers an opportunity on a continuing basis to update their knowledge, to exchange views through free discussion and also to have necessary guidance from expert counsellors.

Every teacher at plus two level should be put through an intensive training programme for about two to four weeks once in every three years. These programme should cover teaching methodology, updating of knowledge in respective fields--and insight into the curriculum of plus two level.<sup>2</sup>

Such training centres should be built up with good library and other facilities so that teachers from immediate neighbourhood can come at week-end and discuss relevant classroom materials and various problems<sup>5</sup> faced by them in the Centre. No training programme, inservice or pre-service can meet with success unless teacher training institutes have facilities of good library. There is dearth of suitable textual and other instructional materials for both pre-service and in-service teacher training programme here in the State. So, initiative should be taken first to develop handbooks for teachers illustrating the new techniques of teaching, information of the new development in the subject matter and also the new areas in mathematics.<sup>6</sup> Suggestions for undertaking experimental projects and action on research may also be included in the handbook. Such a guide book for teachers accompanying every textbook could help a teacher to meet all the requirements in a class. It will also help

to understand some difficult parts of the syllabus that is needed to be illuminated. In addition to this, a complete guide book providing better suggestion on lesson plans, use of audio visual material, test items, historical notes etc. on important units may also be prepared to provide concrete help to teacher training programmes. A library of a teacher training institutes should also have teaching aids, mathematical kits, charts models films etc.

#### 5.2.02. Training for School Teachers

Training programmes only for college teachers is not enough to improve the whole educative system of mathematics teaching. It is highly desirable to look at the root of the problem also. The foundation of a student is made in his school days. Therefore, care should be taken so that the students at elementary, middle and secondary level get the benefit of right instruction. For this purpose, it is necessary that the teachers of those levels also go through the similar training programmes. In fact, the problem is more acute at these school levels. Mathematics is a compulsory subject right from elementary to high school stage. In Meghalaya, most of the elementary schools, particularly, in rural areas have only one or two teachers. In middle schools

or even in high schools one may not find separate mathematics or science teachers. No doubt, this pattern of manning the educational system demands immediate arrangement for the training programmes. Since only a few school teachers have got proper mathematical background, such a training programme should include fundamental concepts in mathematics. The task of training school teachers at different stages is the largest and most significant from the point of view of raising the general level of mathematics background. Such a programme will also create a new climate for mathematics education which is not only important but also desirable. The mode of training programme can be institutional or correspondence. Though institutional training is more effective, it may not be possible in the state to organise institutional training for a large number of teachers on a continual basis. Moreover, teachers of the schools of remote areas may fail to come frequently to the training centres. So, the structure of the training programme could be as follows: an institutional training programme can be organised for two to four weeks. This can be arranged for a particular area. After intensive contact training they can go back to their places of working. After this, they may have correspondence lessons which will be given to them along with reading materials. This

process may continue for about six months. It is suggested that such institutional-cum-correspondence course should be followed by an examination for evaluation purpose.<sup>78</sup>

It is of course, not that there does not exist any training institution for school teachers in Meghalaya. But there is no specific centre or institution where mathematics-teachers are separately dealt with. There is no training facilities for college teachers teaching at plus two stages at all. The present situation of teacher-education in the state is far from being satisfactory. They are mostly theory oriented and have failed to serve the purpose, specially of the mathematics teaching. The method of teaching in teacher's training college need also to be changed. Here efforts should be made to update the minimum academic and professional requirements of teachers offering mathematics as one of the practising subject as far as practicable. Besides, emphasis should be given to improve methods of teaching, integration of methodology with the content, and objective based evaluative practices. Also the ineffective lecture may be replaced by effective use of group-learning and distance learning materials etc. on mathematics teaching.

Training programmes may be organized in various ways; but, no one of them can be a success without the

participation of government agencies. So state educational authorities, SCERT, Secondary Education Board etc. should take active part in undertaking the training programme which should be worked out by a department of education at the state level. Besides attempts at the state level, an organisation may be set up at the national level also. Most of the items of the training programme may be taken care of at state level, but there are some elements which will require planning and direction from a central body. As for example, reading material and correspondence lessons can be prepared by this organisation. Also it may carry on the programmes of Summer Institute, various seminars, workshops at all India level etc. It is heartening that the central government with the introduction of NEP has designed arrangement for massive teachers-training all over the country through nodal agencies like SCERT/SISE etc. NCERT, New Delhi has already started the task of Massive Teacher Training Programmes in all the states. However, here is a suggestion. The massive teacher training programme launched by NCERT may not be sufficient for the State of Meghalaya because of the obvious reasons discussed so far in Chapter II of the thesis. Some special programmes on improving the mathematics education as a whole is desirable for the state. Additionally, the NCERT programmes will not

cover, in general the plus two stage. So, for this particular stage, separate programmes should be launched.

### 5.3. Improvement of the Curriculum

Remarkable developments had taken place in Mathematics during the last few decades through various research activities. The following information will speak for itself as to what extent the developments in mathematics has occurred. "Mathematical Review" which gives brief reviews of research papers and books had 1650 large double column pages in 1960, about 2220 pages in 1961, about 2500 pages in 1962, about 2800 pages in 1963, and about 3100 pages in 1965. Mathematical knowledge has been estimated to double in a period of about ten years. The present rate is still faster.<sup>8</sup>

This tremendous explosion of mathematical knowledge has its impact on the University Syllabi in most of the countries around the globe. But the situation is somewhat different in India. The static syllabi followed in most of the Indian Universities give the impression as if mathematics has ceased to grow. Our mathematics syllabi have undergone negligible changes both in spirit and content during the last few decades. To present mathematics as a living, vibrant and dynamic intellectual enterprise to our students rather than as a stagnant

pool of knowledge, reformation in curriculum cannot be avoided.<sup>9</sup> The dependence of modern scientific society on mathematics is recognised throughout the world and the requirements of the society get changed along with the tremendous changes occurring in science and technology. Because of this outmoded curriculum followed in school or college stage retards the progress of the society. Thus, the need of changing the mathematics curriculum at all levels is quite genuine and this should be done on priority basis.

The overall goal of teaching mathematics is to enable the students to think logically, quantitatively and precisely; that is, to develop in them the habit of thinking mathematically. The students should be trained in schools in such a way that they develop the proper understanding of mathematical concepts and acquire ability to apply them in various situation. In other words, the main object of mathematics education in schools is to make the pupil mathematically literate so that they develop the appreciation for mathematical language.<sup>10</sup> This language does not consists skills in addition, subtraction, multiplication and division but it requires intuitive and structural concepts, the elementary knowledge of which can be imparted at upper secondary level. Along

with these modification, concepts of equations and inequation, real and complex number system can also be given at secondary level. Care should be taken so that at the doorstep of plus two level, they learn completely the grammar of deductive reasoning. The problem of the large gap between the secondary level and plus two level is a big problem of Meghalaya and it can thus be overcome by introducing the new curriculum of mathematics as suggested here.

So far as plus two level curriculum is concerned it cannot be said outmoded. But certainly it also needs some modification to bring it upto the national standard. In Meghalaya one of the major problem is that the plus two level curriculum is designed with the basic assumption that the students are equipped with some mathematical training on fundamental concepts and principles. But in practice, this sort of training they get in HSLC courses is not sufficient at all to meet the mathematical requirement at plus two level. To get rid of this difficulty, modification of HSLC mathematics curriculum is necessary. Prior to it, a remedial course of duration of two months or so may be offered at the entry point of plus two level.

As discussed in the previous chapters, the prevailing plus two curriculum for mathematics is a bit low standard compared to the national curriculum. This problem can be solved by readjusting the desired topics, like geometry of three dimension, introducing lessons of set theory, etc. Also at this level modern topics of various branches of mathematics can be offered to the students as optionals so that they can opt for a stream according to their aptitudes and interest. This may be a significant step towards the orientation of the students at this level. We all know that people have different temperments and aptitudes. Some are quick learners while some are slow learners. Some have aptitudes for broad learning while others excel in specialized areas. Individual educational objectives are also at variance. That is why it is advocated for flexibility, not only in the curriculum, but in the educational system as a whole. In other words, the system should not be so rigid, that a student who has opted for a particular stream cannot change over to another at a later stage when he discovers his real interest in something else.

It is to be noted at this point that one of the main objectives of the mathematics education is to identify and nurture the gifted students also, since

they form the part of the human resource of the country. At the same time, care should be taken for the 'slow learner' also, because, mathematics is an indispensable tool of various professions. Keeping in view of social requirements we cannot but diagnose the slow learners. Particularly, in a state like Meghalaya, unless special devices are adopted to raise the standard of the mathematically backward class of the state, the deep rooted problem of this backwardness may not find any solution,<sup>11</sup> even after the implementation of NPE.

For slow learners, methods of individualised instruction could be the most effective one.<sup>12</sup> In order to evolve the suitable measures to help them, it is required firstly to locate their difficulties. Check lists and compilation of student's error in different topic can be prepared by the teachers for this purpose. Since it is the teachers who will diagnose them, therefore, to help them in this direction, manuals, giving suggestions for remedial work, and a set of graded exercises on different topics may be prepared for the teachers so as to guide them. Such manual or guide book for the teachers should also indicate the sequential learning steps and levels of difficulty in different topics. Wherever possible, simplified courses may be offered

to them, where it is not emphasized on rigorous and abstract proofs of the mathematical propositions.

On the other hand, gifted students should also be provided with special educational programmes. To identify the gifted students, Talent Search Examination (TSE) and similar schemes can be set on from time to time. Such competitive examinations, contests should also be held frequently to cater to the interests, curiosity and quality of logical thinking of this class of brighter students. It is seen that attention is paid mostly on the mathematically backward students, and no special provision has been made to nurture the interest of the brighter students. As a result, such students gradually loses their interest in mathematics and drifts away from mathematics in their higher courses of studies. So effort must be taken not to kill their interest in mathematics but to accelerate it. To nurture the individual inquisitiveness, concept formation is more essential rather than computational skills. So emphasize should be given upon highlighting the unified concepts in mathematics. The two possible ways of nurturing a brighter student may be (a) to guide him in the proper direction of his choice, and (b) to provide him enrichment material there.<sup>13</sup>

Problems evading the logical, critical and rational thinking in the learning of mathematics is necessary for a brighter student. Such a class should be guided for indepth study of different topics. Care should also be taken to remove their misconceptions, and to suggest them new interpretation of those. Thus, the creative thinking power in them may be developed.

Along with this, these students may be provided with suitable instructional materials to encourage self-learning. Those may be supplementary books on some related advanced topics, handbook of investigatory projects related to topics prescribed in the syllabus etc. Difficult mathematical problems on different topics may be enlisted for the willing learners so as to encourage them to take up challenging programmes. Besides, various teaching units or modules, showing the application of mathematical topics in different subjects and important areas of life such as communication transport etc. may also be prepared. They may be provided with optional courses.

Mathematics club activities, quiz contests, olympiad etc. should be started as special programmes. To locate the gifted students a state level +2 Mathematics olympiad may be held every year, and the selected students may be given scholarships for their continued study

of mathematics. Such a step will help to motivate the students in learning mathematics and at the same time it will help to nurture the best mathematical talents of the state.

#### 5.4. Integrated Approach of the Curriculum

So far Mathematics has been taught as a collection of some facts, some techniques and some theorems of various branches which bear very little relation to one another. The whole curriculum is subdivided into few branches, namely, Algebra, Geometry, Calculus, Vector Analysis and so on. Each of these branches is the collection of separate topics which need separate treatment, separate procedures. Also, these are taught in such a way that the students see no application of these fragmental mathematics in any of practical field. As a result, he begins to look at mathematics as an unrelated body with a number of tricks to be used mechanically for the purpose of examination which are otherwise useless.

The solution of this problem can be found in the concept of integrated approach which stresses in unifying mathematics education into one, making it more meaningful to the learners. Integrated approach relates the teaching of mathematics to the various experiences in the area of the learners. It serves in four aspects:

1. Integration within mathematics.
2. Integration with other subjects of study.
3. Integration with day-to-day experience, and
4. Integration of mathematics teaching within the different level of education.

Bhatnagar<sup>14</sup> expressed these aspects mathematically in a very precise way. According to him, mathematics curriculum should be a function of four variables given by  $C = C(x,y,z,t)$  where 'x' denotes the integration of teaching of mathematics, 'y' denotes the integration of teaching of mathematics, 'z' denotes the integration of mathematics education with the needs of the society and 't' denotes the integration of mathematics from Primary to University education.

In teaching mathematics, this model of integrated approach should be remembered. Teachers of pure mathematics may draw examples showing where and how these theories are being used. Similarly, they may also indicate the correlation of mathematics with other subjects like Economics, Psychology, Physics, Chemistry, and Bio-sciences. This would be an effective way to make mathematics more living and more exciting.

The curriculum of mathematics should also be more precise and more definite than the existing one. Only the listing of topics does not make it a complete one. Along with the topics every relevant details should be mentioned. An outline of teaching methodology should be indicated in the curriculum. All the topics should be accompanied by additional notes showing their correlation within as well as outside mathematics. In other words, particular and general aims of each topic should be emphasized effectively.

#### 5.5. Production of Textual Material

The implementation of curricular development is deeply related to the production of developed instructional material. Any reformation in curriculum should quickly be followed by publication of textbooks.<sup>15</sup> The problem of textbooks in the state is yet to receive a satisfactory solution. Textbook being the only important instructional material here, it should get top priority. Truly speaking, the want of good textbooks has caused a barrier in learning mathematics. Textbooks may be written by the teachers who have long experience of teaching in this region. Only then the standard and desirable texts may be produced. Such a text may be of real help to the students of the state. But at the same time care should be taken that

they do not confine themselves only on those books. They should also be exposed to other allied textbooks. Such books should be made available particularly, to the gifted students of the state. Scope of a textbook should be beyond the requirements of examination. As mentioned earlier, an important task of textbook is to motivate the learners towards mathematics. For this purpose, a brief history of mathematics may be incorporated in the textbooks wherever possible. Each unit should be accompanied with the background story and brief history lying behind the developments of the topic.<sup>16,17</sup> This is intended to motivate the learners. Topics in textbooks should be suitably punctuated with interesting episodes from the lives of the great mathematician wherever possible.

Textbooks are normally revised with each revision of the curriculum. Competent mathematicians of the region should be encouraged to write good textbooks for all levels with the financial support of the state government for proper scrutiny and trial of the books before they are accepted for publication.

#### 5.6. Popularisation of Mathematics

One of the major task is to spread mathematics education for creating an awareness for it. The real

problem of mathematics education of this state have always been to develop an educational process in mathematics which will produce people who are not afraid of mathematics but who can enjoy studying it. This problem is to be handled in a number of ways.<sup>18</sup>

#### 5.6.01. **Mathematics with Realistic Application**

Mathematics has always derived the greatest strength from its application. This fact is required to be visualised by all. This can be done, as mentioned earlier, by showing the application of mathematics along with the teaching of the subject, so that the learners can develop the trust that mathematics can help in solving all types of problem in physical, biological and social sciences.

#### 5.6.02. **Encouraging Creativity in Mathematics**

The ultimate aim of education is not just to acquire knowledge. It should also lead to creativity on the part of the learners.<sup>19</sup> Problems of varying degree of difficulty can be designed by the teacher to inculcate creativity. Some of them may be out of the content. While learning, a student should feel that he is able to apply his mathematical knowledge in creating something.

### 5.6.03. Organization of Competition in Mathematics

In USA, USSR and East European countries mathematical 'Olympics' have played an important role in finding mathematical talents and encourage it.<sup>20</sup> In our country also mathematics 'Olympiad' have been introduced for plus two level students with the same purpose. However, this competition has not been popular in Meghalaya. So along with this a similar competition on state level is recommended. The best talents of the state should be awarded an attractive scholarship so that keen interest can be grown for mathematics.

### 5.6.04. Organisation of Mathematics Quizes, Exhibition etc.

Mathematical quizes and exhibition etc. can be organized in the state level where all the colleges may take active participation. Quizes can be on topics like interesting mathematics understandable by everyone, the lives and works of great mathematicians, amusing numbers including mysteries of numbers. Such an effort are observed in national level, which does not reach this state. Now-a-days quizes on popular mathematics are being shown in T.V. and these are quite popular. Such programme should be organized in every college frequently. Exhibition can be organized once in a year in the state level, where mathematical models, charts paper

foldings. exhibiting mathematical principles etc. can be shown. Such exhibition needs a good publicity and should be open for all and it should be seen that the students take active parts instead of being mere spectators.

#### 5.6.05. Organisation of a Mathematics Club or Mathematical Association

To initiate all sorts of activities to popularise mathematics mentioned above, formation of a mathematical club or an association is very necessary. Because, when we talk about quizzes, exhibitions, etc. in the state level, question arises who are to organise them. Such a question can be answered with the formation of mathematics club. Teachers and students and the other interested persons from various walks of life can be member of such club or association. This club may arrange debates, quizzes and exhibitions on mathematics and can celebrate the birth anniversary of great mathematicians. It can also provide a large number of mathematical puzzles, games, recreational mathematics etc. to the interested people. Besides these, they can publish a mathematical journal which is another important service for the creation of mathematical awareness in the society. Now, the question is who will sponsor this club. Various public and government agencies should come forward with financial help in this regards. North-Eastern Hill University and the

colleges under its coverage can also make a humble beginning in this direction. Such a club or association can function properly only with sound financial support.

If all the ways suggested above can be implemented in the state, the condition of mathematics education is bound to improve, while it shall not be impossible to get a group of talented students in mathematics. They will be sound in mathematics and will be capable to meet the mathematical requirements of the state. This will also be helpful in creating an environment for study of mathematics all over the state.

#### **5.7. Improvement in Institutional Facilities**

To have a better educational system, particularly in mathematics, betterment of the institutions viz. schools and colleges is the foremost necessity. Inadequate attention and lack of arrangement in providing better institutional facilities have been noticed all over the State, and this is to be removed first in order to improve mathematics education. For this purpose, the following steps may be taken into action.

##### **5.7.01. To Increase the Number of Teachers to the 'Desired' Standard**

It is clear from the earlier discussion that most of the colleges of Meghalaya is lacking in the

requisite number of teachers. As a result, it becomes impossible to regulate the size of a class, and a teacher is to teach in a class of even 200 students whereas the desired size of a Pre-University class should not contain more than sixty students. The first task in improving the institutional facilities is to lower down this high student-teacher ratio in all colleges of the state. Recruitment of more mathematics teachers, it is strongly recommended to reduce the load of the existing teacher-class.

#### 5.7.02. To Improve Library Facilities

In most of the colleges in Meghalaya library facility is poor. The libraries keep normally the prescribed textbooks and other substandard books. Magazines and Journals particularly, on mathematics are almost totally absent in college libraries of the state. It is a fact that a good library is very necessary for sound mathematics education where sufficient number of books on different branches mathematics, history and development of mathematics, the biographies of famous mathematicians and mathematical periodicals, journals etc. are there. The main reason of not having these is the limited financial resource of the colleges. But there is no urge for it too. The issue of building up a good library in

all the institutions has not been seriously thought. All the colleges should seek help from the relevant agencies to build up a modern library with all sorts of books and journals of mathematics related to undergraduate level. This must be open always for students and teachers of mathematics and new arrivals in the library should be conveyed to the students and teachers. The library should also receive generous grants.

#### §.7.03. Use of Educational Technology

The mathematics teachers of the state are suffering due to dearth of suitable instructional materials and other teaching aids. Practically they get nothing except a blackboard and chalk as teaching aids. In most of the colleges they do not even get a blackboard with graphed surface. A teacher needs many instruments by the help of which he can give his 'best' to the students with the teaching aids supplied to the teachers, the students can be motivated towards the learning of mathematics to a great extent. The improved quality of educational technology makes the teaching of mathematics understandable. Models and charts prepared on some particular topics on mathematics can be used to clarify the relevant concepts. Their visual nature often provides clear and immediate insight which are normally difficult and time consuming to explain verbally.

To reduce the level of abstraction of the teaching, a teacher can use audio visual aids as possible means. Living nature of audio visual aids can provide variety and freshness to teaching of mathematics. Consequently, the entire environment gets improved since the students enjoy their learning through such aids. For a slow learner the learning situation becomes formidable and effective with the help of teaching aids.<sup>21</sup> Few audio visual aids that can be used in a class are:

(i) **Projectors** - Projectors enable the teachers to display certain item to the entire class at the same time. Complicated diagrams and picture can be prepared in advance and then these can be projected by the help of a projector.

(ii) **Films and Filmstrips** - Films and Filmstrips are the most commonly used visual aids in developed as well as developing countries. Because of its attention drawing qualities, it is capable of making mathematics-teaching more attracting, more effective and more meaningful. A film or film strips can be made to introduce a unit or lesson through a series of pictures arranged in logical order to tell the salient features to explain an idea or to show steps in a process. This is surely a better approach compared to the method of learning mathematics

by reading from books alone; because, such films can inculcate into learners' mind the aptitude of inquiry, observation and other mathematical methods.

#### 5.7.04. Introduction of Mathematical Laboratory

The colleges may introduce a 'mathematics laboratory' which will be the centre for all mathematical activities within the college. Such a laboratory helps to develop the desire to experiment in the mind of a learner which is very important.<sup>22</sup> In these laboratories the mathematics teachers may exhibit some of the application of the mathematics and can guide the students to some practical work according to the learner's aptitude. A mathematics laboratory should be well equipped with necessary apparatus, such as, calculators, computers, films, filmstrips, projectors etc. Some mathematical games may also be kept for the students which will help to popularize the study of mathematics.

#### 5.7.05. Use of Radio and Television

It is an established fact that Radio and Television have powerful impact on imparting educational techniques. But the time allotment given by the Radio Station for educational broadcast is very limited. In order to make the full use of this media, more time in educational programme should be given. These broadcasts should include

time to time the important and recent mathematical events and also talks on mathematical discoveries, lives of great mathematicians, etc.

With the incoming of the television to this region, this medium too can be well utilised for educational purpose.

#### 5.7.06. To Hold Seminar, Workshop Etc.

So far we have been talking about seminars, workshops only for teachers and mathematicians. But seminars and problem-solving sessions can be organized in every college also which may be open for the willing class of students. Seminars can be organised at inter-college level also where the students of all the colleges of the state may participate.

#### 5.7.07. Introduction of Remedial Course

The problem of backwardness, particularly, in mathematics over the state is discussed earlier. Proper attention should be paid to these backwardnesses. This is mostly the concern of mathematics teachers in order to improve mathematics education. In this regard, introduction of remedial courses for the weaker students may prove helpful.

Such a remedial course should take care of psychological problems of the students mentioned earlier. For example, some of the students may need more practice and drill work than the others. An intelligent student may pick up the idea just after solving one problem when some slow-learners may need to solve ten problems to pick up the idea. The remedial course designed for the purpose should not overlook such facts.

A distaste for the subject is developed due to the lack of understanding the fundamentals.<sup>23</sup> The peculiarity of the subject like mathematics is that if one develops some doubts about the fundamentals at any stage, this will hinder his/her progress all throughout. The remedial course should take care of this also. All the problems illustrated must be worked out with every details of the fundamental theory lying behind it along with footnotes and points to be noted carefully.

At plus two level, the students come from varied background even though they may be broadly comparable in their aptitude and intelligence. Students coming from more 'backward' areas or from the schools which are not very well equipped are often constrained with handicaps of following the class-teaching. So remedial course at plus two level may be started before the start of regular

classes in the colleges. Such course may also be run simultaneously with the class-teaching at least for six months. In the first instance, all the students joining the institutions may be tested in depth so as to identify their weaknesses. On the basis of their weaknesses, they may be divided into small groups having broadly similar deficiencies. Remedial courses should be made according to the need of each of these groups or even for individual student, if possible. After the removal of initial deficiency, the periods allotted for remedial course can be converted into the tutorial classes.<sup>24</sup>

It is a fact that the all round backwardness of the state is to a great extent, an inherited one and it is mostly due to the low I.Q. estimated to be lower than 70. This difficulty can be minimised only by raising the I.Q. by 7 or 8 points. The removal of such difficulty should be a joint responsibility of the mathematics teachers at all levels and the government agencies dealing with educational system. Massive as well as extensive task should be initiated in the state to this work.

#### 5.8. Reforms in Examination System

Examination, as we all know, is a process of evaluating the achievement of the learner. It is certainly an essential part of teaching-learning process but not the

goal or aim of education, as it is considered by the learners at present. So, the educationists of India have unanimously emphasized the need to carry out radical reforms in examination system. Because, the present system of examination all over the country has failed to give correct information about the students' achievement. The UGC too has made valuable recommendations in this regard.

Firstly, evaluation should be continuous process; that is, a student's performance should be measured on a continual basis. In Meghalaya, like most of states of India, a final examination is held at the end of two years at plus two level and evaluation is done on the basis of the performance in this final examination alone. It is suggested that the gradual progress of the student should be assessed over well-distributed intervals of time. Tests should be so designed as to assess the students' capacity for comprehension, application and creative ability. This frequent opportunities for evaluation enables the teacher to assess the progress made by each student and also to ascertain the need for extra attention.

The performance of the student in the class tests should count towards his final assessments at the end of two years of teaching. Some flexibility should be allowed

in the weightage to be given to the periodical tests in the final awards. This weightage can be announced at the beginning of the course itself.

Secondly, the teacher responsible for teaching a course should also be responsible for evaluating his students. Thus, the examination should be internal and the teacher should be the person to set question and examine the answers. Thirdly, the present practice of awarding marks at the final examination do not fulfill the objectives of evaluation. It should be replaced by a grade system<sup>25</sup> whatever is suitable for the state.

After the announcement of the result of each test examination, the answer scripts should be shown to the students in order to enable them to know their mistakes and understand the assessments. The correction process should also be such that the mistakes are clearly shown and meaningful comments are made in the side of the answer book. Our present examination system emphasizes only the subject matter goals. It does not give an opportunity of knowing how far students learn to argue logically, precisely and quantitatively in a mathematical as well as in a non-mathematical frame. The test held for the students should reveal such fact also.<sup>26</sup>

In order to implement the suggestions made so far, there may be the need of restructuring the educational system of the state. But this should be done if the mathematics education of the state is really wanted to enter into a new era of mathematical achievements.

#### 5.9. Concluding Remarks

It is earnestly hoped that the survey presented herein will serve to make the concerned departments and authorities in the State of Meghalaya aware of the fact that it is high time for them to go with the modernising the mathematics curriculum to meet the challenges of the 21st Century. On the basis of our findings we hereby would like to offer the following recommendations in general:

1. There should be a preparation for the Material of Instruction as (a) the means of organising modern instruction, (b) the number of hours of study devoted to mathematics to be well defined, (c) the conditions for working in the class to be laid down upon, (d) the subject matter of instructions to be ascertained individually for each teacher, (e) the aims and objectives of teaching mathematics at plus two stage to be clearly exposed, and (g) the use of educational technology in the classroom teaching wherever possible to be emphasized.

2. The teaching of mathematics at +2 stage with its precise objectives should be made clear to the teacher and the taught. To do that
  - (a) Steps leading to the learning of mathematics are to be taken.
  - (b) Conditions favourable to the learning of mathematics are to be created.
  - (c) Motivation and learning should be tied together.
  - (d) Various ways and means of learning are to be used.
  - (e) The development of mathematics through problems of conceptualisation is to be stressed.
  - (f) The role of problem-solving while teaching in the classroom is to be emphasized and carried out.
  - (g) In order to make the teaching of mathematics interesting, games and enjoyment relating to the use of mathematics may be introduced suitably fitting with the time schedule pre-determined.
  - (h) The co-operation among mathematicians, educators and psychologists should be established to make the teaching-learning process effective.
  
3. The training and retraining of the teaching community should be initiated for
  - (a) the mathematical preparation of the teachers,
  - (b) keeping them up-to-date,

- (c) the pedagogical preparation of teachers, and
  - (d) the continued education of teachers.
4. The seminars, workshops and discussions among the teaching community involved in plus two stage-teaching should be initiated in order to make
- (a) the teaching of mathematics meaningful,
  - (b) the teaching pattern in all the colleges uniform and also,
  - (c) to understand the occasional difficulties cropped up in the teaching process.
5. Steps are to be initiated for
- (a) creating general awareness as regards to the need and utility of mathematics in the present day context, and
  - (b) popularising mathematics.
6. Essay and Quiz competitions, the olympiads, etc. in mathematics should be started locally within the state in order to have proper mathematical culture among the students, guardians and the teaching community.
7. Our findings reveal that
- I. The current curriculum at plus two level is not serving as large a proportion of the disciplines need mathematics as it should.

II. Mathematics itself is being ill-served by the classical curriculum.

III. The students community is yet to be psychologically ripe for drastic change but their willing to accept the need based changes.



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## APPENDICES

## APPENDIX - I

Table - 5: Abstract from the result of P.U. Examination, NEHU, from 1981-1985.

Year	Total Number of P.U. students		Total Number of P.U. students		Total Number of P.U. students	
	Appeared	Passed	Appeared	Passed	Appeared	Passed
1981	3,300	1,489	907	456	706	237
1982	3,159	1,449	805	402	523	260
1983	4,097	1,383	985	410	719	239
1984	4,444	2,215	840	543	604	259
1985	4,333	2,055	894	545	628	307

## APPENDIX - II

Table - 6: Fall in intake of Mathematics from plus two stage to degree class in the colleges of Shillong.

Year	Number of Students in P.U. 2nd Year offering Mathematics	Number of Students in B.Sc. 1st Year offering Mathematics
1982	564	162
1983	751	157
1984	645	169
1985	660	180
1986	682	202
1987	739	176

## APPENDIX - III

Table - 7: Abstract from the Result of HSLC Examination, MBOSE, from 1980-1983.

Year	Number of students appeared in HSLC Exam.	Number of students passed in HSLC Exam.	Number of students passed in Mathematics in HSLC Exam.	Percentage of pass in Mathematics w.r.to the total number of candidates
1980	2,561	1,389	931	36.35
1981	2,702	1,603	1,068	39.52
1982	2,917	1,546	1,172	39.44
1983	3,226	1,978	1,790	55.48

APPENDIX - IV

Table - 8: Low Intake of Mathematics at +2 stage among Tribal Students of Meghalaya.

Year	Number of Tribal Students in P.U. Exam.		Number of Tribal Students in P.U.(Sc.) Exam.		Number of Tribal Students in P.U. Exam.				
	Appeared	Passed	Percentage of Pass	Appeared	Passed	Percentage of Pass			
1981	2,059	821	39.87	467	167	35.76	273	79	28.93
1982	1,943	801	41.22	415	161	38.8	215	77	35.81
1983	2,565	747	29.12	539	170	31.54	319	73	22.88
1984	3,017	1,439	47.7	483	290	60.04	288	135	46.87
1985	2,874	1,232	42.87	518	287	55.41	310	144	46.45

APPENDIX - V

QUESTIONNAIRE FOR THE STUDENTS AT PLUS TWO STAGE  
WHO ARE STUDYING WITH MATHEMATICS

1. What do you feel about the mathematics syllabus offered to you?
  - (a) Easy
  - (b) Difficult
  - (c) Very difficult
  
2. Do you feel that the content is a big jump from that of HSLC standard?
  - (a) Yes
  - (b) No
  
3. What do you feel about the teaching standards of teaching mathematics?
  - (a) Good
  - (b) Bad
  - (c) Can be followed
  - (d) Cannot be followed, why?

Do you like mathematics? If so, why?
  
5. Do you go for private tutions?
  - (a) No
  - (b) Yes
  - (c) If 'yes', does it help you, In what way?

APPENDIX - VI

QUESTIONNAIRE FOR TEACHERS OF MATHEMATICS

AT PLUS TWO STAGE

1. What do you think about the +2 Mathematics Syllabus?
  - a) Is it a standard one? If not, in what respect?
  - b) Is the syllabus upto the mark compared to the national level? If not, in what respect?
2. Has the syllabus a link with higher growth of mathematics? If not, what do you suggest for that?
3. Is the syllabus fit enough for the students passing HSLC Examination? If not, what do you suggest for it?
4. Do you have any suggestion for improvement of the curriculum?

- B
1. What do you feel about the acceptance of mathematics curriculum by the
    - (a) Students in general
    - (b) Tribal students in particular?
  2. Do you feel that the tribal students have the general tendency to avoid mathematics? What do you suggest in this respect?

C. 1. Do you feel that the teaching of mathematics at +2 level is appropriately handled? If not, why?

2. Do you use any special device to help the slow learners in the class? What special devices do you suggest for this purpose?

D. 1. Do you use any other aid than textbook to teach mathematics in the classroom? If not, what type of aids do you suggest to be used for that at +2 level?

2. Do you feel that the textbooks followed at +2 level are up to the mark? If not, what are the defects and what do you suggest to remove those?

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