CHAPTER VII

TEACHING AND LEARNING MATHEMATICS

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SECTION I

TEACHING AND LEARNING MATHEMATICS
Peter G. Dean has beautifully explained the relationship between teaching and learning. In his words:

"Teaching has to satisfy and stimulate the thirst for learning, so that active learning and teaching are closely linked but are not identical. The link is made clearer by reference to psychological theories of learning, which lead to a discussion and analysis of the methods of teaching mathematics."

Therefore, a knowledge of teaching methods should be linked with a knowledge of the way children learn mathematics. The main task of the teacher is to arouse and maintain the students' interest in mathematics. Most of the teachers know that one of the principal causes of the failure of the students in learning the subject is the loss of interest. In the words of K.S. Sidhu:

"The elements of novelty, usefulness, and sheer intellectual curiosity are the primary stimuli for the awakening of interest. The work should present a continual challenge, but it should be a challenge in the real sense and not merely drudgery at meaningless, difficult tasks. Interest in the subject can be effectively aroused and maintained by numerous special devices and activities."

Prior to 1950's, it was a common belief that each individual had inherited a certain amount and type of intelligence which determined our capacity to learn. This capacity was measured by Intelligence Quotient (I.Q.). But, further studies have shown the amazing capacity of pupils to learn mathematics when they are provided with the right kind of teaching.
"The good teacher provides plenty of mathematics; he knows the different kinds, the methods of teaching and each pupil's capacity at any specific time. During the school year, every teacher should be able to stimulate the pupils' thirst for knowledge and help them to satisfy that thirst."

Some feel that a friendly personal attitude towards students is necessary for successful teaching, but this view is not supported by all academicians. According to Roy Dubisch:

"......, a teacher who is vitally interested in his subject but disinterested in his students can still do an effective job of teaching. I do not mean to imply, however, that a teacher who actually dislikes students can still do a good job. On the contrary, he is likely to be sarcastic and over-bearing, and both of these attitudes are heartily detested by the students."

For effective teaching and learning there must be a close relation between the teacher's activity, the school environment and the mathematics curriculum. In this connection, the explanation of Peter J. Dean is interesting to note.

"It must be emphasized that the actions of a teacher are closely related to three other factors: the actions of pupils, the school environment and the mathematics curriculum. This is represented by the tetrahedral surface in figure No.4, where each face meets the other three along their common edges to represent the many points of interaction. The shaded face is uppermost because a teacher is responsible for controlling the situation. He has to assess the probable interactions, and
Figure 4. A teacher’s actions relate to, and control, the three other factors.

(Source - PG. Dean, Teaching and Learning Mathematics, P. 32.)
then select an effective style of teaching which is modified by the actual interactions which occur during a lesson. The teaching style does not necessarily put the teacher in a dominant role and he may often expect the pupil to do a great deal of independent study. However, the teacher must realize that his job includes taking responsibility for choosing that particular style.\(^5\)

There are certain characteristics of good teaching of mathematics. Generally teachers try to adopt new styles for improving their teaching so as to enable the students to learn effectively.

"These characteristics apply to all stages of education and a good description of them was expressed by the Schools Council team which investigated mixed ability mathematics teaching in secondary schools. In their book, the team members listed the following six desirable aspects:

Quality -

a) Sound mathematical content and variety of tasks.

b) Suitability of tasks for pupils (appropriate level of difficulty, interest and relevance).

Continuity -

a) Continuity and development of the mathematical learning of individual pupils.

b) Awareness by the teacher of individual pupils' progress.
Figure 5 Teaching activities for Dienes' six stages
(Source: P.G. Dean, Teaching and Learning Mathematics P.70)
Autonomy -

Development of the pupil's ability to organise his own learning activities.

Discussion -

Mathematical discussion between pupils and between teacher and pupil.

Another suggestion has been made by Servais and Varga regarding the absence of drill in the teaching of mathematics. According to them, 

"Another remarkable characteristic in the new mathematics teaching, closely related to the cyclic course of learning, is the almost total absence of drill in developing skills or in memorizing facts, as an independent activity. Skills in formal arithmetic, for instance, are not developed by doing sums mechanically, but by activities which lead to interesting new concepts and knowledge. In terms of the above, while completing the last stage, a new cycle is being started. The new activity may be the solution of equations or of inequations, first by simply guessing, then by consecutive approximation, in each case by substituting the supposed roots and testing whether they satisfy or not." 

The activities of teaching mathematics have six stages according to Dienes. He has presented the six stages in the form of a diagram.

Peter G Dean is of the opinion:

"We have reached the stage of considering a pupil who has a capacity for learning and a teacher who has a capacity for"
teaching. Although teaching and learning are closely related in schools, it is important to realize that a theory of teaching is not the same as a theory of learning. It is also important to distinguish between learning which is instigated and encouraged by a teacher and learning which occurs as part of a child's natural growth and development.

Without schooling, a child would take a long time to recognize triangles, because in family life, he sees only a few triangular objects and numerous objects of many other shapes. A teacher will want to accelerate this recognition and so may give three different shapes only - circles, squares and triangles - made of rather similar materials. This teaching action quite likely originates from theories of how children naturally acquire concepts, rather than theories of how they can best be taught these concepts. This is because, at present, mathematics teaching does not have a formulated theory of its own, so it has to depend on theories of general teaching and theories of mathematical learning.8

Methods of Teaching:

Teaching is an art. Methods are the ways to understand and practise the art. Every method should aim to develop accuracy and speed in mathematics. To be effective, a method must be simple and clear to the students.

<p>| TABLE 7.1 |
| USE OF METHODS IN TEACHING |</p>
<table>
<thead>
<tr>
<th>Methods used in teaching</th>
<th>f</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Always</td>
<td>21</td>
<td>9.55</td>
</tr>
<tr>
<td>Sometimes</td>
<td>188</td>
<td>85.45</td>
</tr>
</tbody>
</table>
The Table 7.1 demonstrates that 5% of the teachers never teach mathematics according to the prescribed pedagogical methods. 85.45% of the teachers use such methods sparingly; and only 9.55% of the teachers believe that they follow the methods they had learnt in teacher training institutions.

In mathematics, the methods, if applied appropriately, promote better understanding. A continuous in-service teaching programme, adequate teaching aids, supply of latest books and journals relating to mathematics teaching and effective supervision may all be able to generate a general climate of pedagogical approach to the teaching of this highly conceptual subject in place of the rules of the thumb, practised till to-day.

**Reason for not applying Methods:**

It was noticed that some of the teachers did not apply the modern methods in teaching this subject. Some reasons were suggested in the questionnaire and scope was given to the teachers to add other reasons if found worth mentioning.
TABLE 7.2

REASONS FOR NOT APPLYING MODERN METHODS.

<table>
<thead>
<tr>
<th>Reasons</th>
<th>f</th>
</tr>
</thead>
<tbody>
<tr>
<td>i) Lack of time</td>
<td>151</td>
</tr>
<tr>
<td>ii) Lack of students' participation</td>
<td>72</td>
</tr>
<tr>
<td>iii) Lack of ancillary facilities</td>
<td>64</td>
</tr>
<tr>
<td>iv) Unsuitable time-table</td>
<td>26</td>
</tr>
<tr>
<td>v) Constraints of examination</td>
<td>25</td>
</tr>
<tr>
<td>vi) Lack of motivation</td>
<td>11</td>
</tr>
</tbody>
</table>

(Vide Question No. 2 in the 'Teaching' section of the Teachers' Questionnaire).

Besides the reasons mentioned in the Table 7.2 in order of importance, some more reasons were suggested by a few teachers.

a) The syllabus was heavy. In order to cover up the syllabus in time methods could not be followed.

b) The students lacked fundamental knowledge and skills in mathematics. Adopting 'training college methods' may take more time and the courses cannot be finished in time.

c) Lack of administration and supervision.

The methodologies expounded in the Teachers' Training Colleges are all imported from either U.S., U.K., or some developed countries. They are theoretical expostulations devoid of practical demonstrations. Indigenous methodologies rooted in the
socio-cultural ethos of this country have not yet been developed. For long, there was servile imitation of anything British. After 1960's the American jargon was adopted. In such a situation, the teachers need not be blamed for not adopting "the methods". There are various methods and modes of teaching mathematics. No single method is liked or used by all the teachers of mathematics. Teachers differ, so also their methods and modes of teaching.

A list of methods was suggested to the teachers and they were asked to indicate the methods that appealed to them.

**TABLE 7.3**

**APPEAL OF METHODS OF TEACHING MATHEMATICS**

<table>
<thead>
<tr>
<th>Methods</th>
<th>f</th>
</tr>
</thead>
<tbody>
<tr>
<td>i) Analytic method</td>
<td>94</td>
</tr>
<tr>
<td>ii) Inductive method</td>
<td>42</td>
</tr>
<tr>
<td>iii) Synthetic method</td>
<td>41</td>
</tr>
<tr>
<td>iv) Deductive method</td>
<td>38</td>
</tr>
<tr>
<td>v) Lecture method</td>
<td>5</td>
</tr>
</tbody>
</table>

N =220

(Vide Question No.3 in the 'Teaching' section of the Teachers' Questionnaire).
The Analytic Method preferred by 94 (42.7%) out of the total 220 responding teachers had correctly stated their stand. It has been the oldest method and is analogous to anatomical vivisection. A compartmental analysis of mathematical problem is an easy task for a mathematician-trained or untrained. The 'Deductive Method' is a close supplement, but the teachers—of whom 43.72% were untrained—were under qualified and among the qualified ones 46.8% were untrained—could not understand the pedagogical jargon. Lecture Method is totally unsuited to the organizational structure of mathematical concepts; and had rightly been rated very low. The Inductive Method and Synthetic Method are quite challenging and require rigorous practical training in the field, which most of the teachers lack.

Skill of drawing Geometrical Figures:

The main purpose of drawing geometrical figures is to enable the pupils to get acquainted with the common geometrical concepts and figures. They will examine and handle geometric models, straight lines, curved lines, angles, triangles, polygons, circles, cubes, cuboids, cylinders, spheres, etc. The pupils will be mainly guided to experience the symmetry, variety, regularity, and beauty of forms in nature and practical arts. They will be taught how to keep and handle the instruments of their geometry-boxes.
Out of the 220 teachers, 211 teachers stated that they regularly taught their students the skill of drawing geometrical figures in the class. Only 9 teachers i.e., approximately 4.1% of the teachers stated this aspect of geometry to be not very important, and that they paid marginal attention to this aspect.

Lack of geometrical instruments in the schools is a major deterrent. Apathy, lack of aptitude and competence were also responsible for such an attitude.

**Drawing Charts:**

Charts and maps help in creating a suitable subject atmosphere in the class-room. They cover a vast range of mathematical topics. Charts should be preferably multicoloured and artistic so as to create interest among the pupils. The teachers should arouse the interest of the pupils in preparing mathematical charts.

It was observed that 98 teachers (i.e., 44.54%) did not teach the students the skill of drawing mathematical charts.

**Mathematical Models:**

Models are very useful aids, because they can be handled and manipulated. There is pleasure in their making. These aids have a creative value. All the geometric forms can be cut out of card board or a thick paper; and used as models.
75 out of 220 teachers i.e., 34.1% of the teachers of Orissa did not encourage their students to prepare mathematical models. For generating a mathematical bent of mind at the secondary school stage, the teachers should initiate the students in the preparation of mathematical models.

Geometrical Constructions:

Students can learn by imitation. If the teachers perform geometrical constructions in the class, the students learn the techniques of handling geometrical equipments, drawing figures and making constructions of different sizes and shapes. Therefore, the teachers should demonstrate the techniques of geometrical constructions.

All the respondents opined that they performed geometrical constructions in the class. The situation seems to be satisfactory in this respect. But a closer look at the state of affairs provides a traditional and unimaginative approach. Geometry is the spring board to sculpture, art, architecture and advanced designing. Creativity and innovation are not allowed a free-play. The traditional triangles and the queer quadrilaterals dominate the geometry notes.
Participation of Students in Geometrical Experiments:

Experimentation provides the innate adventurism. It provides ample scope for trial and error. It is the source of innovation. Experiments with shapes and sizes are quite intriguing and enchanting. It can be developed as a creative hobby.

198 out of 220 respondents allowed the students to participate in geometrical experiments. But 22 respondents i.e exactly 10% of the mathematics teachers of Orissa did not allow the students to participate in such experiments.

The so called experimentation was nothing short of the 'experimental proofs' deduced for theorems. The teachers themselves seemed not to have understood the true import of experimentation in geometry. They did not know how to establish interlinkages with architecture, surveying, designing, sculpture, etc.

Reference Books:

Textbooks have an unchallenged sway over the classrooms. In fact, their tyranny is almost unbearable. Reference books can break this monopoly and monotony but rarely are they accessible to the students. A variety of books catering to the needs of students of different abilities can arouse interest for this subject. Reference books contain topics included
in the syllabus and taught in the class. But the topics are presented in novel ways. Therefore, the pupils should have access to a sufficient number of reference books.

Good reference books are not available. However, 167 teachers stated that they consulted reference books and the rest were frank enough in admitting that they did not consult reference books.

**Textbooks for Classroom Preparation:**

The teacher should be well-prepared before entering the classroom. He has to clarify the doubts of the students and help them in solving difficult problems. Teachers of mathematics should depend less on textbooks for classroom preparation and should increasingly consult reference books.

36.81% (i.e., 81 out of 220) of the teachers opined that they solely depended on textbooks for classroom preparation. 139 teachers did not do it.

The teachers of Orissa need to be oriented to use reference books, workbooks, etc. for classroom preparation.

**Mathematical Journals:**

Explosion of knowledge is a spectacular phenomenon today. Mathematics is no exception. The teachers of mathematics should be acquainted with the advances in the field.
Journal and magazines, very often, contain the latest information. Teachers must be in the habit of studying journals to keep themselves abreast of the latest developments.

**TABLE 7.4**

**READING MATHEMATICAL JOURNALS**

<table>
<thead>
<tr>
<th>Reading journals</th>
<th>f</th>
</tr>
</thead>
<tbody>
<tr>
<td>Regularly</td>
<td>x</td>
</tr>
<tr>
<td>Occasionally</td>
<td>200</td>
</tr>
<tr>
<td>Never</td>
<td>20</td>
</tr>
</tbody>
</table>

(Video question No.11 in the 'Teaching' section of the Teachers' Questionnaire).

It transpired that 9.09% of the mathematics teachers never read journals at all. 90.91% of the teachers read journals occasionally. But none of the mathematics teachers of Orissa read the journals of mathematics regularly.

Lack of quality-journals, lack of funds and the smug satisfaction with one's professional standing are the bottlenecks for the absence of a love for the study of journals.
Encouragements to read Journals:

Students should be encouraged to have a penchant for mathematical journals. 166 teachers stated that they encouraged their students to read mathematical journals whereas 54 teachers i.e., 24.54% of the mathematics teachers of Orissa stated that it was not a feasible activity.

There should be adequate journals in the library and the students should be encouraged to read journals.

Teaching:

Eternal vigilance is the price that teachers have to pay to maintain high standards in their profession. Teachers' perception of the prevailing standard was assessed through a question.

TABLE 7.5
STANDARD OF TEACHING

<table>
<thead>
<tr>
<th>Standard of teaching</th>
<th>f</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average</td>
<td>128</td>
</tr>
<tr>
<td>Poor</td>
<td>61</td>
</tr>
<tr>
<td>Good</td>
<td>31</td>
</tr>
</tbody>
</table>

N = 220

(Vide question No.8 in the 'Facilities' section of the Teachers' Questionnaire).
According to 58.18% of the teachers of mathematics in Orissa, the standard of teaching mathematics was average. 27.72% of the teachers opined that teaching was poor. Only 14.09% of the teachers considered the standard of teaching to be good. Teachers were not satisfied with the prevailing standards of teaching, and so they expected improvements in this regard.

**Causes of Low Standard:**

Teaching is adversely affected due to various reasons; some are organisational and others environmental. Some of the reasons are the allotment of classes, duration of time for each class and number of working days for the subject. The table 7.6 explains about the affected teaching.

**TABLE 7.6**

**CAUSES THAT ADVERSELY AFFECT TEACHING**

<table>
<thead>
<tr>
<th>Causes</th>
<th>No. of teachers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inadequacy of teaching periods per week.</td>
<td>69</td>
</tr>
<tr>
<td>Shorter duration of periods.</td>
<td>96</td>
</tr>
<tr>
<td>Reduction in the number of working days.</td>
<td>100</td>
</tr>
<tr>
<td><strong>Total =</strong></td>
<td><strong>265</strong></td>
</tr>
</tbody>
</table>

(Vide Question No.13 in the 'Teaching' section of the Teachers' Questionnaire).
All the 220 teachers had not responded to item (a), (b) and (c) of Question No. 13.

Out of 170 teachers responding to Question No. 13(a), 69 teachers had opined that the requisite number of periods per week was not allotted in the school time-table. As such, the teaching of mathematics was affected. However, 100 teachers out of 170 teachers (58.82%) of the teachers of mathematics of Orissa were satisfied with the number of periods available for teaching mathematics.

Previously a school day had seven periods and now there are eight. The average duration of a period has decreased from 45 minutes to 35 minutes. The teachers of mathematics felt that a period of 35 minutes was too short to impart effective teaching. But administrative realities constrained their freedom. They had to stop teaching just when they were in the middle of an explanation and the students were fully warmed up. This is a highly frustrating experience. 56.47% or more than half of the mathematics teachers expressed their anguish.

Normally a school is expected to have 250 working days. Examination, strikes, festivals and a lot of other exigencies like flood, out break of fires, elections—interfere with the even tenor of the school schedules. The number of working days is diminishing every year. The limited working
days are utilised to finish the course in a hurry. Hence the result is disastrous. The academic climate of most of the schools is adversely affected due to the decrease in the number of working days.

**Periods per Week:**

Adequate number of periods should be made available in the school time-table for teaching mathematics to enable the teachers to complete prescribed course with thoroughness.

<table>
<thead>
<tr>
<th>Periods</th>
<th>f</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>153</td>
</tr>
<tr>
<td>6</td>
<td>67</td>
</tr>
</tbody>
</table>

| N = | 220 |

(Vide Question No.1 in the 'Facilities' section of the Teachers' Questionnaire).

In 69.54 % of the secondary schools of Orissa, 5 periods in a week were allotted for teaching compulsory mathematics. The rest 30.45 % of the schools, provided six periods in a week.
Relating to the previous question, the researcher desired to know the number of periods, the teachers required for teaching compulsory mathematics in a week.

The responses of the teachers were presented in the Table 7.8.

**TABLE 7.8**

<table>
<thead>
<tr>
<th>Periods</th>
<th>f</th>
</tr>
</thead>
<tbody>
<tr>
<td>8</td>
<td>58</td>
</tr>
<tr>
<td>7</td>
<td>31</td>
</tr>
<tr>
<td>6</td>
<td>94</td>
</tr>
<tr>
<td>5</td>
<td>37</td>
</tr>
</tbody>
</table>

(Vide question No.2 in the 'Facilities' section of the Teachers' Questionnaire).

26.36% of the teachers (58) of Orissa wanted 8 periods a week for teaching compulsory mathematics. 14.09% of them wanted 7 periods, 42.72% of the teachers wanted 6 periods and only 16.81% of the teachers wanted 5 periods.

The teachers of mathematics opined that periods available for teaching mathematics were inadequate. Therefore,
six or seven periods are to be provided in the time-table for teaching compulsory mathematics. The mean of the periods wanted was 6.5.

Emphasis on Problems:

Generally, importance ought to be given to the topics according to the difficulty-level so that the students may be able to understand all the topics included in the syllabus. If selected problems are given undue importance only with the examinations in view then students are likely to concentrate on such topics and neglect the rest. Such a situation may produce perceptively 'good results', but it ultimately sabotages the very foundations of teaching and learning. The 'examination-centred' approach to teaching has created such a situation in the schools of Orissa.

It was seen that 184 teachers of mathematics in Orissa emphasised some problems which were generally set in the examinations.

This malady can be rectified in two ways. Firstly, the same type of problems should not be repeated in the examinations every year; and secondly, the teachers should not make the students concentrate on some problems only from examination point of view. A balanced and judicious approach is the panacea for this malady.
Teaching for Understanding:

In mathematics, understanding is more important than mere knowledge. If understood, facts can be remembered and applied. Mathematics is a subject full of concepts and abstractions. It must be understood properly so as to derive the true pleasure of its learning.

It was found that 177 teachers i.e. 80.45% of the teachers teaching mathematics emphasised understanding of all the students. 19.54% of the teachers did not emphasise this aspect.

Learning mathematics is not at all possible if concepts, abstract ideas are not understood. Therefore, all the teachers of mathematics should emphasise understanding of the students in learning mathematics.

Mathematics as a Compulsory Subject:

To most of the teachers, guardians and also students, mathematics appears to be a dry, difficult and uninteresting subject. In such a case, some teachers may not like mathematics to be a compulsory subject.

86 i.e. 39.1% of the teachers of mathematics in Orissa opined that mathematics should not be compulsory for
all the students 60.90% of them (i.e 134 out of 220) pleaded in favour of mathematics to be a compulsory subject.

Mathematics, basic to human knowledge, ensures a worthy life. Therefore, mathematics should be compulsory up to secondary stage.

Mathematics Room:

In order to create an atmosphere of mathematics during teaching and learning, a separate room is necessary. Aids to teaching mathematics can be preserved and used at the appropriate time.

It was found out that 218 schools out of 220 i.e. 99.1% of the secondary schools of Orissa did not have a separate room for teaching mathematics only two (0.9%) of the schools had separate rooms. These were mostly rural schools managed by private trusts, which had evinced keen interest in educational matters.

Attitude towards Mathematics:

Unless and otherwise students have a positive attitude towards the subject, they cannot learn effectively. Teachers may be sincere, may teach through best possible methods and ways but the students are to learn. Students' attentiveness and the desire to learn play significant role in learning. For this
they must love the subject. The students were asked to express their attitude towards learning mathematics.

**Table 7.9**

**ATTITUDE TOWARDS LEARNING MATHEMATICS**

<table>
<thead>
<tr>
<th>Attitudes of Students</th>
<th>f</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>I derive pleasure in studying mathematics</td>
<td>293</td>
<td>52.7%</td>
</tr>
<tr>
<td>It is impossible to live without a knowledge of mathematics.</td>
<td>208</td>
<td>37.4%</td>
</tr>
<tr>
<td>I feel disgusted to studying mathematics</td>
<td>51</td>
<td>9.1%</td>
</tr>
<tr>
<td>It is a total waste of time</td>
<td>4</td>
<td>0.7%</td>
</tr>
</tbody>
</table>

\[N = 556 \text{ } 99.9\%\]

*(Vide Question No.2 of the Students' Questionnaire)*

Table 7.9 revealed that 55 (51 + 4) students out of 556 i.e. 9.89% of the students reading mathematics in Orissa did not like the subject at-all. They thought that their time was being unnecessarily wasted in studying mathematics 52.7% of the students had a positive love for the subject; and 37.4% of the students considered it as an indispensable subject. On the whole, the students have a very positive attitude towards the subject.
Mathematics vis-a-vis other Subjects:

The attitude of the students towards mathematics vis-a-vis other subjects is reflected in the Table 7.10.

<table>
<thead>
<tr>
<th>Attitude towards Mathematics</th>
<th>f</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>I love mathematics like all other school subjects.</td>
<td>262</td>
<td>47.1</td>
</tr>
<tr>
<td>I have greater love for mathematics than the other school subjects.</td>
<td>226</td>
<td>40.6</td>
</tr>
<tr>
<td>I love mathematics the most</td>
<td>56</td>
<td>10.0</td>
</tr>
<tr>
<td>I do not love the subject</td>
<td>12</td>
<td>2.1</td>
</tr>
</tbody>
</table>

\[N = 556\quad 99.8\%\]

(Vide Question No.38 of the Students' Questionnaire)

Mathematics was related pretty well vis-a-vis to the other school subjects. It was not an unpopular subject. However, a microscopic minority of 2.1% of the students positively disliked the subject, which is offset by the high motivation expressed by 10% of the students.
Branches of Mathematics:

At the secondary school stage, there are mainly two branches of mathematics; viz. Algebra and its application and Geometry and its application. Mensuration has been treated as application of geometry. Generally students love a definite branch of mathematics more than all the branches. There are very few students who love all the branches equally well.

It was the intention of the researcher to know the preference of branches according to the liking of the students.

**TABLE 7.11**

GRADATION OF BRANCHES LIKED BY STUDENTS

<table>
<thead>
<tr>
<th>Branch</th>
<th>f</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Algebra and its application.</td>
<td>185</td>
<td>32.2 %</td>
</tr>
<tr>
<td>Geometry and its application.</td>
<td>371</td>
<td>66.7 %</td>
</tr>
</tbody>
</table>

N = 556, 99.9 %

*(Vide Question No. 35 of the Students' Questionnaire).*

'Geometry and its application' was more popular among the students compared to 'Algebra and its application'.
Understanding the theorems on Geometry:

Theorems on geometry should be properly understood by the students so as to apply their knowledge of geometry in other fields of knowledge. In construction and solving the problems of mensuration, the understanding of geometrical theorems is essential.

**TABLE 7.12**

UNDERSTANDING THE THEOREMS

<table>
<thead>
<tr>
<th>The way the theorems understood</th>
<th>f</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Understood all the theorems</td>
<td>228</td>
<td>41 %</td>
</tr>
<tr>
<td>Understood most of the theorems</td>
<td>116</td>
<td>29.8 %</td>
</tr>
<tr>
<td>Remembered all theorems by rote learning but understanding a few.</td>
<td>104</td>
<td>18.7 %</td>
</tr>
<tr>
<td>Did not understand and remember</td>
<td>58</td>
<td>10.4 %</td>
</tr>
</tbody>
</table>

\[N = 556\] 99.9 %

(Vide question No. 7 of the students questionnaire).

The Table 7.12 revealed that 10.4 % of the students of Orissa neither understood nor remembered the theorems of geometry. 18.7 % of the students remembered all the theorems but understood a few of them. 29.8% of the students remembered all the theorems but understood most of them. The rest 41 % of the students had both understood and remembered the theorems of geometry.
Majority of the students did not understand either all the theorems or some of the theorems of geometry. Care must be taken by the teachers of mathematics to enable the students to understand the theorems. The situation seems to be alarming. Rote learning of geometry defeats the very purpose of the subject. 66.7% of the students ranked it as the branch of their choice in Table 7.11. This means that geometry as a subject was a good mark-fetcher and so was rated high.

For each of the classes VIII, IX and X, two textbooks in mathematics were prescribed by the Board of Secondary Education, Orissa. In all the textbooks, exercises after each topic were included for practice and revision. The problems included in the exercises were either solved in the classroom or assigned to the students for their home work. However, it was expected that the exercises would be done by the pupils. The manner in which the exercises of 'Algebra and its application' were attempted by the students has been presented in Table 7.13.

**Table 7.13**

<table>
<thead>
<tr>
<th>Manner of solving exercises</th>
<th>f</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Solved all problems in the exercises.</td>
<td>235</td>
<td>42.2%</td>
</tr>
<tr>
<td>Solved most of the problems in the exercises.</td>
<td>216</td>
<td>38.8%</td>
</tr>
</tbody>
</table>
Manner of solving exercises

<table>
<thead>
<tr>
<th></th>
<th>f</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Solved a few problems in the</td>
<td>87</td>
<td>15.5%</td>
</tr>
<tr>
<td>exercises.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Never solved any problem in</td>
<td>18</td>
<td>3.2%</td>
</tr>
<tr>
<td>the exercises.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>N =</td>
<td>556</td>
<td>99.3%</td>
</tr>
</tbody>
</table>

(Vide Question No. 5 of the students' Questionnaire)

From the Table 7.13, it was seen that 3.2% of the students did not solve problems included in the exercises. 15.6% of the students solved a few of the problems from the exercises and the rest 81% of them either solved all the problems or most of the problems.

The teachers of mathematics should see that the students solve all the problems included in the exercises of mathematics textbooks. This will not only develop practice and rigour but also understanding.

Constructions:

Constructions help students to develop their conative skills. Thorough understanding of the geometrical theorems is necessary for construction. It is a way of applying the knowledge learnt in geometry.
TABLE 7.14
PERFORMING GEOMETRICAL CONSTRUCTIONS

<table>
<thead>
<tr>
<th>Performing geometrical Constructions</th>
<th>f</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>All constructions contained in the books were drawn in the notebook.</td>
<td>236</td>
<td>42.44 %</td>
</tr>
<tr>
<td>Some selected constructions were drawn in the notebook.</td>
<td>160</td>
<td>28.77 %</td>
</tr>
<tr>
<td>Constructions done in the class were drawn in the notebook.</td>
<td>132</td>
<td>23.74 %</td>
</tr>
<tr>
<td>Not drawn due to dislike</td>
<td>28</td>
<td>5.03 %</td>
</tr>
<tr>
<td>N =</td>
<td>556</td>
<td>99.98</td>
</tr>
</tbody>
</table>

(Vide Question No. 9 of the Students' Questionnaire).

Out of the sample of 556 students of Orissa, 28 students i.e. 5.03 % of the students, disliked constructions and they did not do constructions at all.

23.74 % of the students of Orissa reading mathematics did the constructions which were done in the class by the teachers.

28.77 % of the students were in the habit of doing constructions selectively.

And the 42.44 % of them performed all the constructions included in the geometry textbooks.
It is obvious that 57.55% of the students (320 out of 556) were not habituated to performing all the constructions in the books. Some did selected constructions, some neglected totally and some did constructions which were done in the class. The students should be motivated to do constructions and their work be checked regularly.

Mensuration:

Mensuration is the application of geometry. Students who understand geometry can solve the problems of Mensuration with ease.

Out of 556 students, 64 students (i.e. 11.51%) disliked to solve problems on mensuration and the rest 88.49% liked it. Out of 492 students with a liking for solving the problems on mensuration, 256 students (52.03%) were habituated in doing all the problems included in mensuration. 84 students out of 492 (17.07%) liked to solve a few problems only, and the rest 30.89% (152 out of 492) were in the habit of solving easy ones leaving aside the difficult problems.

It revealed that 47.98% of the students were not regular in solving the problems on mensuration.

Solved Examples:

Solved examples in the textbooks of mathematics are essential for both the teachers and the students. Teachers
can enlighten themselves with the method of solving the problems. They can assist the students in their self-learning and in clarifying their doubts. It is heartening that there are a good number of solved examples in the textbooks prescribed and published by the Board of Secondary Education, Orissa.

**TABLE 7.15**
**STUDYING SOLVED EXAMPLES**

<table>
<thead>
<tr>
<th>Examples study by students</th>
<th>f</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Study all the solved examples</td>
<td>272</td>
<td>48.9 %</td>
</tr>
<tr>
<td>Study some of the solved examples</td>
<td>272</td>
<td>48.9 %</td>
</tr>
<tr>
<td>Not study at all</td>
<td>12</td>
<td>2.2 %</td>
</tr>
</tbody>
</table>

\[ N = 555 \quad 100 \% \]

(Vide Question No. 12 of students' Questionnaire)

Table 7.15 showed that 48.92 % of the students had read all the solved examples included in the mathematics textbook and the same number of students had read some of the solved examples and the rest 2.15 % had not read the solved examples at all.
Books of Similar Contents:

Students should not be satisfied with the reading of textbooks prescribed for them. To be thorough especially in mathematics, they should read books having the same content but written by different writers.

In order to know the habits of the students in reading other books of mathematics with same content Question No. 13 was included in the Students' Questionnaire.

227 students i.e. 40.83% of the students of Orissa opined that they were reading other books having the same content according to their syllabus. But 59.17% of them did not read other books of mathematics with the contents as per their textbooks. The test papers and notes constitute the supplementary reading material. Very often, it is the poor students who are not in a position to supplement their reading of the text due to financial stringency.

Study during the Examination Period:

Generally, the students burn midnight oil during the examination period. The phantom of examination creates in them a fear-psychosis. So, students of all categories - intelligent, normal and backward - pay much importance to examination; and as such labour hard in studying and writing.
An attempt was made to investigate the reading habits of students during the examination period. 344 students (61.87%) exerted more and devoted much time to the studying of mathematics during the examination period. But 212 students (38.13%) did not do so.

Students have to face two examinations in an academic session - the half-yearly examination, and the annual examination. The school session starts usually in the last week of June and the first term comes to an end in December. The half-yearly examinations are held in December before the schools close for the X-mas holidays. The half-yearly examination is a mid-term appraisal and alerts the students.

The short-term or the second term of the school lasts from January to May. The annual examination is usually held either in the last week of April or early May. This examination is crucial to the students as promotion to the next higher class solely depends on the results of this examination. The annual examinations are taken very seriously by the students, teachers and the parents.

Evidently, differential weightage is accorded to the results of the two examinations. Students exert more for the session-end examination than for the mid-term examination. Table 7.16 reflects the relative importance given to these two examinations by the students.
TABLE 7.16

HOURS OF STUDY PER DAY BEFORE HALF-YEARLY AND ANNUAL EXAMINATION.

<table>
<thead>
<tr>
<th>Hours</th>
<th>Before half-yearly Examination</th>
<th>Before annual Examination</th>
</tr>
</thead>
<tbody>
<tr>
<td>8</td>
<td>24</td>
<td>47</td>
</tr>
<tr>
<td>7</td>
<td>16</td>
<td>32</td>
</tr>
<tr>
<td>6</td>
<td>32</td>
<td>134</td>
</tr>
<tr>
<td>5</td>
<td>25</td>
<td>64</td>
</tr>
<tr>
<td>4</td>
<td>231</td>
<td>119</td>
</tr>
<tr>
<td>3</td>
<td>55</td>
<td>104</td>
</tr>
<tr>
<td>2</td>
<td>173</td>
<td>55</td>
</tr>
</tbody>
</table>

\[ \text{N} = 556 \quad \text{and} \quad \text{N}=556 \]

(Vide Question No. 18 (c) and (d) of Students' Questionnaire)

**Studying Alone or with Friends:**

Some students like to study independently but some others like studying in the company of friends. An attempt has been made to analyse the study habits of the students.

Out of 556 students 304 students (54.68%) preferred to study mathematics alone; and the rest 45.32% liked to study mathematics in groups.
Tuition or Special Coaching:

Now-a-days tuition is an indispensable part of the educational system. It is special assistance rendered by the teachers to enable the students to enhance their achievement. In the rat-race of examinations, 'marks' are the be-all and end-all of the entire educational system. There is a sort of 'marks mania' among all and nothing is fair or foul when it comes to bolstering the marks. Parents, teachers and middle-men are actively engaged in this heinous racket.

Special coaching can be defended on the ground that it is remedial education for the backward students and enriched curriculum for the gifted that is being provided by the teachers, of course, for a fee. Everyone criticizes it but none fails to fall in its love. The underpaid teachers bank upon tuitions for supplementing their income. A large number of corrupt practices have crept into tuitions as a result it has turned out be a lucrative commerce instead of being an art of genuine succour.

Mathematics is a difficult and abstract subject. Most of the students who flock for tuitions clamour for special coaching in Mathematics and/or English. Naturally, mathematics teachers ply on the lucrative trade of private tuitions. Sometimes students are coerced to take tuitions.
It came to light that as many as 437 out of 556 (78.6%) were undergoing 'tuitions'. It is only the poor students who cannot afford the cost, stay away from tuitions.

**Coaching Classes:**

Some of the students fail to keep pace with class-room teaching. Ordinary class-room teaching is impaired by the average teachers for the average students to ensure average achievement. The 'underachievers' and 'dullards' fail to catch up. As already discussed in the preceding section, almost 8 out of every 10 students opt for tuitions.

However, there are certain schools and teachers who still adopt a missionary approach in contrast to the universal mercenary approach. They conduct 'coaching classes' to assist such of the students who lag behind.

In as many as 50% of the institutions of the sample, some sort of coaching classes were conducted. The students' perception of the coaching classes is not entirely positive. As many as 277 out of 556 students of the sample did not favour 'coaching class'. They considered the coaching classes to be additional burden on the camel's back. 20.7% of the students abstained from attending such classes but the overall response was highly favourable.
Rich parents prefer special treatment for their children; and so do not send their children to coaching classes, they prefer tuitions. The dull and backward avoid these classes because they find them boring and uninteresting.

Use of Guides and Notes:

For easy solution of the problems on mathematics - geometry, algebra and mensuration, students use 'guides', 'notes' or 'key' books. A variety of key books are readily available in the market. These books have high mischief value. The "possible questions", "guessing" and 'Tips for success' very often mislead the students. But it is a thriving racket in which a few unscrupulous teachers and publishers are actively involved to grind their own axe.

28.77% of the students of Orissa (160 out of 556) used key books whereas the rest 71.22% of the students did not.
SECTION II

TEACHING AIDS IN MATHEMATICS

"The equipment of a school is a matter which requires great care. We regret to say that we have noticed many schools where there was hardly equipment, and subjects were taught under conditions where boys were forced to memorise rather than understand what was taught." 9

The Education Commission of India (1966) stated:

"The supply of such basic equipment and teaching aids to every school in the country is essential for the improvement of the quality of teaching. It would indeed bring about an educational evolution in the country. We recommend that lists of minimum teaching aids and equipment needed by each category of schools should be prepared. These may be kept as economical and frugal as possible. But once a certain minimum equipment is considered necessary, steps should be taken to see that it is given to every school on a high priority basis." 10

Prof. Sidhu in his book 'The Teaching of Mathematics' had stated,

"Mathematics is essentially a subject, where doing is more prominent than reading. That is why a certain amount of equipment is indispensable in order to make even a start in this subject. Moreover, it is held by a vast majority of people that mathematics is a dry and difficult subject, full of abstract things. The result is that students take very little interest in it. To create the necessary interest is a constant problem for the teacher. This subject demands the use of aids at every step." 11
Mathematics requires extensive use of aids more than any other subject. In this connection Aggarwal says,

"No field makes more use of visual and objective aids than does mathematics. We cannot imagine an effective mathematics classroom without blackboards, or pupils working without pencil and paper. Models and devices are almost indispensable. The visual aids make the classroom an interesting place, thus making the various steps in the learning sequence more effective, and discovering strengthening the special interests and capacities of individual students. These aids should be to create interest, yield information and challenge creative power. The ultimate purpose is to assist the student to do abstract reasoning, attain general concepts and interpret results. The modern visual aids are motion pictures film strips, slides, opaque projectors, still pictures, models and charts. Properly used, they widen the variety of approaches possible for developing concepts and understandings in an interesting and meaningful way."  

For teaching mathematics, certain minimum requirements like charts, equipments and apparatus are essential. Schools have to make those things available to the teachers of mathematics at the secondary stage. Table 7.17 depicts the availability of the charts, equipments etc. in the schools.

<table>
<thead>
<tr>
<th>Equipments</th>
<th>More than Sufficient</th>
<th>Sufficient</th>
<th>Insufficient</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Black board</td>
<td>10</td>
<td>116</td>
<td>44</td>
<td>220</td>
</tr>
<tr>
<td>Chalk</td>
<td>37</td>
<td>162</td>
<td>21</td>
<td>220</td>
</tr>
</tbody>
</table>
The preceding table graphically illustrates the abject paucity of essential teaching aids. 21 schools lacked the requisite amount of chalk; 44 schools did not possess adequate number of black boards, and dusters were insufficient in as many as 57 of the schools. These are the dearest essentials and a school system that is unable to provide the minimum working conditions can hardly expect good results. In other respect

<table>
<thead>
<tr>
<th>Item</th>
<th>Quantity</th>
<th>Total</th>
<th>Quantity</th>
<th>Total</th>
<th>Quantity</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Duster</td>
<td>19</td>
<td>144</td>
<td>57</td>
<td>220</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Graph cloth</td>
<td>-</td>
<td>23</td>
<td>197</td>
<td>220</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Geometry box</td>
<td>-</td>
<td>104</td>
<td>116</td>
<td>220</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Models</td>
<td>-</td>
<td>18</td>
<td>202</td>
<td>220</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Charts</td>
<td>-</td>
<td>11</td>
<td>209</td>
<td>220</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Film strips</td>
<td>-</td>
<td>-</td>
<td>220</td>
<td>220</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Portraits</td>
<td>-</td>
<td>21</td>
<td>199</td>
<td>220</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Levels</td>
<td>-</td>
<td>14</td>
<td>236</td>
<td>220</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stencils</td>
<td>-</td>
<td>8</td>
<td>212</td>
<td>220</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3-D Geometrical models</td>
<td>-</td>
<td>66</td>
<td>154</td>
<td>220</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Weights</td>
<td>-</td>
<td>39</td>
<td>181</td>
<td>220</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tap</td>
<td>-</td>
<td>47</td>
<td>173</td>
<td>220</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(Vide Question No.10 in the 'Facilities' section of the Teachers' Questionnaire)
the picture is dismal, and a deep sense of anguish and frustration is engendered when one surveys the bleak situation.

Nature of Finance and Purchase:

The teacher of mathematics is the real person to purchase books, reference books, teaching aids and equipments according to his own requirements in teaching mathematics.

**TABLE 7.18**

<table>
<thead>
<tr>
<th>Mode of purchase</th>
<th>f</th>
</tr>
</thead>
<tbody>
<tr>
<td>Getting money when the teacher needed to purchase.</td>
<td>9</td>
</tr>
<tr>
<td>Did not get according to the requirement of the teacher.</td>
<td>146</td>
</tr>
<tr>
<td>Headmaster and headmistress purchase according to their own desire.</td>
<td>65</td>
</tr>
</tbody>
</table>

(Nvide Question No.12 in the 'Facilities' section of the Teachers' Questionnaire).

The Table 7.18 revealed that 66.36% of the teachers did not get money according to their requirements. In 29.54% schools, headmasters or the headmistresses purchased according to their desire. Only in 4.09% of the schools, the teachers of
Use of Aids:

It will not serve the purpose if the teaching aids are purchased and stored in the school. Timely and proper use is more important. Aids are not for storage or dumping.

60.43% of the students (336 out 556) said that teachers used charts, geometry box, models, graphs and rollers, etc. during teaching. But 39.56% of the students opined that the teachers did not use the teaching aids during teaching.

Frequency of Use of Teaching Aids:

For teaching mathematics, some essential teaching aids are barely needed. However, a list of selected teaching aids was given to the students to indicate the frequency of their use in the classroom. The responses have been recorded in Table 7.19.

TABLE 7.19

<table>
<thead>
<tr>
<th>Teaching Aids</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>Geometry box</td>
<td>2032</td>
</tr>
<tr>
<td>Graph cloth</td>
<td>1632</td>
</tr>
<tr>
<td>Models</td>
<td>887</td>
</tr>
<tr>
<td>Charts</td>
<td>683</td>
</tr>
</tbody>
</table>
From the Table 7.19, it was seen that Geometry box was used more frequently than the other teaching aids. Graph cloths were also used by teachers. But models and charts were sparsely used. The use of radio and film strips was non-existent.

Mathematical Games and Co-Curricular Activities:

Co-curricular activities enrich the learning process. Quality of education mainly depends on the input of co-curricular activities. A variety of co-curricular programmes are generally executed keeping in view the curricular requirements of subjects like literature, history, geography, science, etc. However, mathematics-oriented co-curricular activities are extremely limited. Most of the teachers feel that Mathematics cannot be taught through playway, at least at the secondary and tertiary levels. Teachers have not been trained in this regard; and even outstanding teachers of mathematics lack in innovative ideas in this field.
The students were asked to name mathematical games that they enjoyed. Only 21 students stated that they played the following two games:

1. Business
2. Mathematical Quizzes.

This is a highly neglected area of mathematics curriculum and need to be enriched through concerted efforts of imaginative teachers.

Preparation of Mathematical Models:

Concretisation of abstract concepts facilitates learning. This is apposite and apt for a highly conceptual subject like mathematics. The involvement of students in the preparation of mathematical models is sure to generate greater interest and provide motivation for learning.

Like mathematical games, this activity, too, is a highly neglected area, though it has high learning potential. Only 69 students out of 556 had participated in the preparation of various models like parallelograms, cubes, spheres, prisms, and models related to trigonometry, mensuration and algebra.
SECTION III

HOME WORK IN MATHEMATICS
School time is insufficient to completely cover the curriculum of mathematics thoroughly. Homework provides scope for application, practice, and for supplementing class-room teaching. It becomes all the more important and necessary in view of the inadequacy of time allotted to mathematics in the time-table.

According to Roy Dubisch:

"It is generally agreed that homework should be assigned at every class meeting (except when a test is given at the next class meeting). The well-known rule of two hours work outside of class for every hour in class could be applied to gauge the amount of homework assigned. In practice, however, three hours for the average student seems to be much more common for mathematics classes. If homework requiring more than this amount of time is assigned, a large portion of the class will not be able to complete their assignment and will become discouraged. Since problems vary in difficulty, it is impossible here to translate the hourly requirements into a certain number of problems. The beginning teacher can consult his colleagues (being prepared to get a variety of answers!) and he should check with his students from time to time to see how much time they are spending. A rough estimate can usually be obtained by the instructor if he works the problems himself and multiplies the time it takes him by four (this conversion factor, of course, is only approximate and will vary from instructor to instructor, as well as varying for each instructor according to his experience)."

There is a definite principle in assigning homework to the students. The principles have been discussed by Peter G. Dean. He states:
"When teachers set homework, the quantity, level and topic must provide useful mathematical work for the pupils. With pupils of similar ability in each class, the most common method was to set several exercises which provided practice at the current topic being taught; those exercises would then be discussed at the start of the next lesson. This method is still frequently used but such immediate practice is not the only benefit to be gained from homework and a good teacher will probably use it in a variety of ways. Sometimes, for example, revision exercises which relate to previous topics can be set to provide regular reinforcement of pupils' knowledge. Yet another way is to set homework which prepares the pupils for the topic which will be studied in their next lesson."}\(^\text{14}\)

However, the Secondary Education Commission, in its report, has criticised the practice of homework and had made some healthy suggestions. It stated:

\[\text{"It is not only a great burden on the children but is likely to be a threat to their health and a hindrance to the development of proper habits of work. Whatever homework is given - and we are of the opinion that this should be confined to the higher classes - it should be carefully and scrupulously corrected and the mistakes discussed with the students so that their confusions of thought and expression may be gradually eliminated. When a great deal of homework is given and it is not properly scrutinized by the teacher, the mistakes of spelling .... confused thinking remain undetected and are likely to become ingrained. That is why a little homework, well and willingly done and carefully corrected, is far better than great deal of slipshod work, reluctantly accomplished."}\(^\text{15}\)
In mathematics a great deal of practice is necessary. Therefore, homework is a must for the students of mathematics. Homework supplements and reinforces class-room instruction. It assists the teacher in completing the heavy course. It is a sort of feed-back to the parents. The students, at least the high achievers, enjoy homework as it offers them an opportunity to work independently at their own space.

Generally teachers of mathematics assign homework to the students. Though an essential activity, homework should be checked and corrected regularly otherwise it would prove to fruitless.

Out of 220 teachers, 150 teachers (68.18% mathematics teachers) of Orissa were found to have corrected the homework assigned to the students. But 31.81% of the teachers stated that they did not correct the homework.

The teachers were asked as to why they did not correct the homework. Most of the defaulting teachers did not express their difficulty. Only 13 teachers expressed their views. They have been listed below.

1. Heavy work-load and lack of time.
2. Over-crowded classes
3. Number of questions in the exercises were too many and beyond the capacity of a teacher to check up with honesty.

4. Mathematics teachers teach both mathematics and science. Therefore, they have no time.

5. Due to involvement in co-curricular and administrative activities.

6. Students commit too many mistakes. It is not possible to correct all the mistakes.

7. Weak students do not complete the homework at all, and so there is no question of checking up.

(Vide Question No. 17 in the 'Teaching' section of the Teachers' questionnaire).

Time for Correction of Homework:

Some of the teachers prefer to correct homework in the class, and some at home or during leisure time. In order to elicit opinion of the teachers regarding time for correction of homework, a question was included. The responses were as follows:

57.27% (126 out of 220) of the teachers of mathematics opined that homework should be seen in the class. But 94 teachers (42.72%) disliked the idea of correcting the homework in the class.
Time for class preparation and homework:

Now-a-days, the teachers are busy in various activities of the school, private tuitions and other personal problems. They do not have sufficient time for classroom preparation and evaluation of homework.

68 out of 220 teachers (30.91%) stated that they had no time for classroom preparation and for checking up homework.

Students and Homework:

Along with other subjects, the students have to prepare the tasks on mathematics at home. It is expected that they might be having fixed schedule for mathematics.

<table>
<thead>
<tr>
<th>Time spent on studying mathematics in a day.</th>
<th>f</th>
</tr>
</thead>
<tbody>
<tr>
<td>i) 6 hours or more</td>
<td>82 X</td>
</tr>
<tr>
<td>ii) 4 to 6 hours</td>
<td>74 X</td>
</tr>
<tr>
<td>iii) 2 to 4 hours</td>
<td>207</td>
</tr>
<tr>
<td>iv) Less than 2 hours</td>
<td>169</td>
</tr>
<tr>
<td>v) No time is spent</td>
<td>24</td>
</tr>
</tbody>
</table>

N = 556

(Vide Question No. 15 of the Students' Questionnaire).
From the foregoing analysis, it was found that 4.31% of the students of Orissa did not read mathematics at home at all.

30.39% of them spent less than 2 hours in reading mathematics; 37.23% read mathematics 2 to 4 hours a day. 28.05% studied mathematics for 4 to 6 hours or more a day.

Preparation of Homework:

Students differ in their habits as to how they finish the homework assigned to them in order to show it to their teachers in the class. An attempt was made to identify the habits of the students in preparing homework.

**TABLE 7.21**

**TIMING FOR PREPARATION OF HOMEWORK.**

<table>
<thead>
<tr>
<th>Preparation of homework</th>
<th>f</th>
</tr>
</thead>
<tbody>
<tr>
<td>i) The day the teacher assigns the homework.</td>
<td>358</td>
</tr>
<tr>
<td>ii) The day it was to be shown to the teacher in the class.</td>
<td>157</td>
</tr>
<tr>
<td>iii) The day of one's choice</td>
<td>21</td>
</tr>
<tr>
<td>iv) No preparation at all</td>
<td>20</td>
</tr>
</tbody>
</table>

N = 556

(Vide Question No. 16 of the Students' Questionnaire)
From Table 7.21 it was seen that 358 students i.e., 64.38% of the students prepared homework on the day of assignment. 28.23% of the students prepared it on the day it was to be shown to the teacher. Besides them, 3.77% of the students were preparing homework on the day of their choice and 3.6% students did not bother to complete the assignment.

Time of Preparing Homework:

Of course, there is no fixed time to prepare homework. An attempt was made to ascertain as to when the students finished the homework related to mathematics.

<table>
<thead>
<tr>
<th>Time</th>
<th>f</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>i) In the morning</td>
<td>288</td>
<td>51.79%</td>
</tr>
<tr>
<td>ii) After evening</td>
<td>181</td>
<td>32.55%</td>
</tr>
<tr>
<td>iii) After returning from school</td>
<td>47</td>
<td>8.45%</td>
</tr>
<tr>
<td>iv) No fixed time</td>
<td>40</td>
<td>7.19%</td>
</tr>
</tbody>
</table>

N = 556

(Vide Question No. 17 of the Students Questionnaire)
The Table 7.22 revealed that most of the students (51.798 % + 32.553 %) 84.35% of the students prepared homework either in the morning or at night. Only 8.45% of the students prepared homework after returning from school and for 7.19% of the students there were no fixed hours.

Support for Homework:

At home, some students take the assistance of their relatives for completing their homework. But in case of uneducated families, students did not get any help from the members of their families.

First of all, an attempt was made by the researcher to know if they were getting any help from the member of their family.

It was found that out of 556, 317 students i.e., 57% of the students were helped by their relations in their preparation of homework at home. 43% students did not receive any help.

Again the researcher tried to know the relatives of the students who helped them in their homework.

<table>
<thead>
<tr>
<th>Relatives</th>
<th>f</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brother</td>
<td>118</td>
<td>21.22%</td>
</tr>
<tr>
<td>Father</td>
<td>97</td>
<td>17.44%</td>
</tr>
</tbody>
</table>
Table 7.23 revealed that 21.22% of the students of Orissa were helped by their brothers in preparing their homework. 17.44% of the students were helped by their father, 8.45% by their sisters and only 4.67% by some other members of the family. 239 (42.9%) of the students were not in receipt of any help from any of their relatives. They were all mostly from the families belonging to the first generation literacy. Only 5.21% of the students were helped by their mothers.

Herein lies a hidden commentary on the educational backwardness of women of the state.
Nature of Help:

The nature of help, the family members were extending to the students in preparing their homework has been depicted in Table 7.24.

**TABLE 7.24**

<table>
<thead>
<tr>
<th>NATURE OF HELP FOR HOMEWORK</th>
</tr>
</thead>
<tbody>
<tr>
<td>Timing of help</td>
</tr>
<tr>
<td>i) Helped, when asked for</td>
</tr>
<tr>
<td>ii) At times</td>
</tr>
<tr>
<td>iii) Almost at all times</td>
</tr>
<tr>
<td>iv) No help at all</td>
</tr>
</tbody>
</table>

(Vide Question No.22 (h,i,j) of the Students' Questionnaire).

Out of total 556 students, 30.93 % of the students received help when they asked for. 15.82 % of the students got help at times and only 10.25 % of the students received help at all times. 42.9 % of the students did not receive any help at any time. They were the helpless ones who had no one to seek advice from and look up to for guidance.
SECTION IV

LIBRARY
Library has become an integral part of every good school. It facilitates the expansion of intellectual horizon. The library,

"helps in putting progressive methods of teaching into practice. It supplements the knowledge learnt in the classroom. Extra reading makes knowledge complete and comprehensive. It stimulates the students to choose "the best of what has been thought and said". It incidentally educates them for profitable use of leisure. It can help in making a subject lively and interesting, which otherwise is likely to remain dry and monotonous if there is complete dependence on the text-book. Moreover, the text-book cannot satisfy the desire of the brilliant students for more and more information. They can satisfy it through supplementary reading only."

In discussing the present position of Libraries in the secondary schools of India, the Secondary Education Commission had categorically remarked:

"The library may well be regarded as an essential instrument for putting progressive methods into practice. In view of its crucial importance, we consider it necessary to devote some space to discussing how the school library must be organised if it is to play its part effectively in the improvement of secondary education. We should like to state at the outset that in a large majority of schools, there are at present no libraries worth the name. The books are usually old, outdated, unsuitable usually selected without reference to the students' tests and interests. They are stored in a few bookshelves, which are housed in an inadequate and unattractive room. The person in charge is often a clerk or an indifferent teacher who does this on a part time basis and has neither a love for
books nor knowledge of library technique.
Naturally, therefore, there is nothing like
an imaginative and welplanned library service
which could inspire students to read and
cultivate in them a sincere love of books.
What makes this situation particularly
difficult is the fact that most teachers and
headmasters and even the educational admini-
strators and authorities do not realise how
unsatisfactory this position is, and, there­
fore, they have no sense of urgency in the
matter. It is, necessary, therefore, to
give some idea of the Library as
we conceive it.

In the first place the library must be
made the most attractive place in the school,
so that the students will be naturally
drawn to it. It should be housed in a spacious,
well-lit hall (or room), with the walls
suitably coloured, and the rooms decorated
with flowers and artistically framed pictures
and prints of famous paintings. The furniture—
bookshelves, tables, chairs, reading desks —
should be carefully designed with an eye to
artistic effect as well as functional effici­
ency. As far as possible, the open shelf
system should be introduced so that students
may have free access to books, may learn to
handle them and browse on them at their leisure.
In decorating the library, the full cooperation
of the students should be obtained in order to
give them the feeling that it is their own
library. Secondly, the success of the library
depends largely on the proper selection of
books, journals and periodicals. This should
be the function of a small committee of
teachers who have a genuine love for books,
can study book-reviews, consult catalogues
and visit bookshops, if possible. It would
be useful if the same committee could be
entrusted with the work of studying children's
reading interests. Both in this work as well
as in the choosing of books, some senior
students who are interested in reading should
be associated. They are, afterall, the
consumers and their cooperation is likely to
be very enlightening. The guiding principle
in selection should be not the teachers' own idea of what books the students must read but their natural and psychological interest. If they feel more attracted at a particular age to stories of adventure or travel or biographies or even detection and crime, there is no justification for forcing them to read poetry or classics or belleleters.  

Therefore, the school library should contain mathematics books to generate genuine love for mathematics. It must contain sufficient number of mathematics textbooks, reference books, mathematical journals, mathematical hobbies, quizzes, charts and maps of outstanding mathematicians. Library service should be suited to the needs of the students.

A separate 'Mathematics Resource Centre' is an ideal. However, none of the schools of Orissa had a separate library for mathematics. Of the books, most are old and outdated textbooks. Journals are never purchased. Charts and models are conspicuous by their absence.

Only 6.3% of the schools stated that they had reference books on mathematics. The reference books were not available in as many as 182 of the schools. Only 15.4% of the schools took some interest in studying the reference-books. For the vast majority of the teachers and the students, the textbook continues to be the Bible - the source of ultimate knowledge, and, in no way, can it be dispensed with.
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