CHAPTER III

PREVENTIVE MEASURES
Preventive Measures:

The patterns of disabilities that might occur in the students of Class II were localized by the investigator. He then advanced to take preventive measures with the students who were entering Class I so that these kinds of disabilities might not grow in them.

The investigator thought that the most important and ultimate goal of diagnosis was prevention.

Schonell recommended the use of improved types of instructional materials and techniques for preventive purposes. The investigator considered that in teaching-learning situations some factors such as modifications in school organisation, instructional materials, and methods of teaching might be changed for this purpose. Here the improved types of instructional materials - audio-visual materials and techniques - were taken up by the investigator as the preventive measures. The instructional materials (the investigator called them as 'Teaching Units') had been developed by the investigator for 'addition', and 'subtraction' in arithmetic.

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3.1. Teaching Units and the Methods:

The investigator utilized the instructional materials (audio-visual materials and techniques) in teaching the experimental groups (Group A) of the selected weaker schools. The same content areas were chosen for teaching the controlled groups (Group B) through conventional methods. The methods of teaching were the only difference of treating the experimental groups and the controlled groups. He intended to test the hypothesis that the experimental groups taught through audio-visual materials and techniques would achieve more than the controlled groups taught by the conventional methods. The investigator assumed that the present methods and materials followed in the schools led to learning disabilities.

The investigator mainly followed the demonstration method in teaching the experimental groups through improved instructional materials and techniques. He tried to give them opportunity to learn by doing. He assumed that these types of involvement of the students in the teaching learning situation would help them in developing right type of concepts and thus ensure better learning.

3.2. Development of Teaching Units:

In Chapter one the investigator discussed the historical background, the meaning and significance, the present position in India, the limitations and utility of the Teaching Units.

Here he had developed the Teaching Units as preventive tools for eliminating probable disabilities that might develop in the students. These units were mainly based on the specific operations that were required for doing two fundamental processes - 'addition' and 'subtraction' in arithmetic.

Nine Teaching Units \(^1\) five in 'Addition' and four in 'Subtraction', had been developed by the investigator.

The investigator used some novel audio-visual materials while teaching in the classes for which they were prepared. The importance of those materials in this study and the methods followed were also discussed in the following paragraphs:

Some Pedagogical Aspects on Units:

The investigator had presented some fundamental concepts and processes in 'addition' and 'subtraction' in arithmetic before the students through the Units. The analyses of the contents in terms of mental operations were so vivid and extensive that not a single operation was left unnoticed by him. He used:

1. Appendices Nos. 19 to 27, pp. ixL - Lxxi.
(i) different types of audio-visual materials and situations to make the students perceive well,

(ii) the audio-visual materials which were shown to the students who would fail to form relationship in a systematic way, and

(iii) illustrative materials from the immediate environment of the students. The students would be able to learn quickly the number system and their manipulations through the use of concrete aids.

It was believed by the investigator that these Teaching Units would be highly stimulating to the students. It was presumed that the students with a vivid understanding of the basic concepts would be able to learn more than those who had learned through mechanical drilling without proper comprehension.

3.3. Audio-visual Materials:

The audio-visual materials were developed by the investigator for content-areas - 'addition' and 'subtraction' in arithmetic. The followings were the reasons for which these materials were utilised for the experimental groups in classroom teaching:

(i) **Enlarging Perceptual Learning:**

Learning through audio-visual materials would ensure better perceptual experiences, and would help formation of meaningful concepts.
(ii) More Retention of Learning Materials:

The audio-visual materials will cause vivid learning situations. These would impress the students to a large extent. Learning would be retained more with the help of these qualitatively rich perceptual-motor experiences.

(iii) Development of Interest and Initiativeness in the Children:

It was needless to say that the students would be highly motivated when they would be treated with the audio-visual materials. They would be encouraged to spend their leisure time more effectively.

(iv) Gradual Growth of Thinking Process:

The perceptual-motor activities would be presented to the students in a sequential order. The thought processes would be gradual, and one step would lead to another according as the mental horizon of the students would expand.

(v) Developing Rules for Fundamental Processes:

The audio-visual materials were used to form concepts in the children. The materials had no concepts in themselves. The action on the materials produced some meaningful concepts. It was not that some general rules were taught using some rigid
vocabulary, but the 'action' of the mind with the help of these audio-visual materials would help the children conceive more and educe some fundamental laws.

3.4. Experimentation:

(1) Sample of the experimentation:

For preventive measures the investigator followed the strategy of experimental research. He conducted the experiment to test the deduced consequences of the hypotheses he assumed. He selected four schools - all co-educational for his duplicated experiments - two from the rural areas, and two from the urban areas.

The investigator selected two types of schools - rural and urban, because he wanted to know the effect of his experiments on both of these strata of the society. Moreover to have a better control of the independent variable 'sex', he selected both boys and girls' students. Thus the investigator adopted the measures to achieve more generality of his experimental findings. The names, categories, the locations of the schools, and the numbers of students involved in each of the controlled and the experimental groups were noted.

As the investigator proposed to take preventive measures for eliminating the expected disabilities in fundamental processes in arithmetic, he decided to involve the students of Class I at the beginning of the session.

1. Appendices Nos. 16 to 18, pp. xxix-xl.
The investigator arranged in cooperation with the heads and teachers of those schools to conduct his experiments in the month of January and February, 1978.

The four schools (all co-educational) selected for duplicated experiments had different number of students. The investigator faced no difficulty for this inequality as the data was subjected to the analysis of covariance. But he took equal number of students in two groups of a particular school.
The investigator selected four co-educational schools (one urban, one semi-urban, and two rural schools).

In each of the four schools, one section was selected as controlled and the other as experimental group to have homogeneity of the school environment.

The investigator adopted the method of stratification in drawing up the sample.

(ii) Identification of the Independent Variables:

Identification and control of the independent variables were most important prerequisite for the process of experimentation designed by the investigator.

To identify the major independent variables which had a direct impact on the achievements of the students relevant literature was surveyed.

Lalithamma through survey studies concluded that achievement in mathematics was dependent upon intelligence, interest, study habits, socio-economic conditions etc.

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Tama, conducted a study to identify factors responsible for poor results in the secondary school examination, and to examine their bearing on school success. The factors included (i) Intelligence, (ii) Home condition, etc.

Srivastava and Patel in their study found that scholastic achievement of the students would be predicted from academic motivations, socio-economic status, etc.

Srivastava investigated into the factors related to educational under-achievement and indicated that (a) poor study habit, (b) less academic motivation, (c) poor health, (d) poor social and emotional adjustment, (e) personal factors like age, socio-economic status, home condition, were responsible for under-achievement.


Entwistle in his study attempted to unravel the complex determinants of academic achievement. The determinants, he explored, were age, ability, sex, geographical area, classroom organisation, class size, teaching methods and teacher.

Dunham through multivariate analysis established that achievement motivation might be considered as a predictor of academic performance.

Witkin and others surveyed the evidence for sex differences in problem solving, and suggested 'women as a group toward a global field approach in their perceptual and intellectual functioning, men toward an analytical approach'; therefore men should do better in mathematics.


Maccoby suggested, "boys in high school forge ahead in mathematics because they and their parents and teachers know they may become engineers or scientists; while the girls know they are unlikely to need mathematics in the occupations they will take up when they leave school."

Bergland observed in his study "no sex differences in mathematics achievement at the grade 5 level. But at subsequent grade levels (grades 7, 9 and 11) males have higher mean scores than females, and the differences between the sexes increase with age. But an opposite viewpoint was held by Goswami.

Mathur undertook a study which revealed that (i) socio-economic status, (ii) intelligence, (iii) behaviour patterns of the students were highly and significantly correlated with scholastic achievements.


Wadhera while commenting on the influence of 'home' on the academic standard of the school-going children stated, "......... It is original and basic source of informal and incidental learning which subsequently limits and states the individual's quality and rate of progress on different chosen fronts".

The intellectual factors - general and special (including intelligence), social and scholastic conditions, school conditions (attendance, teaching etc) and home conditions were the most important causes of educational backwardness investigated by Burt.

Laziness or lack of intelligence was considered to be the prime factor responsible for students' inability to progress normally in school work. Schonell concluded that the standard of scholastic progress of any student was associated with four main forces (i) intellectual characteristics, (ii) emotional tendencies, (iii) physical conditions, and (iv) environmental influences. He stressed on the attitude of the teacher, use of necessary materials, selection of methods and short systematic lessons for better learning of the students.

3. F. J. Schonell. Backwardness in the Basic Subjects, Oliver and Boyd (Eighth Impression), 1959, p. 3.
Chakraborty and Padma tried out different methods of teaching in the classroom practices and concluded that methods of teaching are vital for the students for better learning and prolonged retention.

Raijiwala studied the effect of Teacher behaviour in the classroom on the performance of the students and found that the behaviour pattern of the teacher determined the academic attainment of the students.

Kumar's investigation was directed towards a different path. He found that home adjustments, social adjustments, emotional adjustment and school adjustments of the students were correlated with their attainments.

The above studies revealed that there were so many variables that had a high and significant correlation with the attainments of the students.

The following independent variables were identified for the control and the list was endorsed by some experienced teachers of high schools and training colleges.


The Independent Variables Identified by the Investigator:

A. Regarding Student
   1. Previous experience.
   2. Sex.
   3. Age.
   4. Physiological conditions.
   5. Intelligence.
   6. Achievement motivation.
   7. Social and emotional adjustment.
   8. Study habits.

B. Regarding School
   10. School environment.
   11. Time of study in school.
   12. Size of the class.
   13. Physical conditions of the classroom.
   14. Number of periods taught.
   15. Content for the study.

C. Regarding Home
   17. Home conditions.
(iii) Controlling the Independent Variables:

After identifying the major independent variables which had a direct impact on the achievement (dependent variable) in mathematics, the investigator attempted to control all the variables except one independent variable (Methods of teaching) which he manipulated to test the deduced consequences of the hypotheses. He considered the performance of the students in the diagnostic tools already prepared by him as the dependent variable.

A diagrammatic representation of controlling the independent variables would show how the investigator proceeded to conduct the experiments.

<table>
<thead>
<tr>
<th>A</th>
<th>Independent variables Nos. 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17</th>
</tr>
</thead>
<tbody>
<tr>
<td>B</td>
<td>Those that would not influence the dependent variable: Nos. 4, 6, 7, 8, 10, 17</td>
</tr>
<tr>
<td>C</td>
<td>Those that might reasonably influence the dependent variable: Nos. 1, 2, 3, 5, 9, 11, 12, 13, 14, 15, 16</td>
</tr>
<tr>
<td>D</td>
<td>Those that could feasibly be controlled by (i) Physical manipulation: Nos. 11, 12, 13, 14, 15 (ii) selective manipulation Nos. 2, 3, 9 and 10</td>
</tr>
<tr>
<td>E</td>
<td>Those that were not controlled by (i) elimination, (ii) holding conditions constant, (iii) balancing, (iv) counter balancing Nos. 5 and 16</td>
</tr>
<tr>
<td>F</td>
<td>No. 16 was made to differ and it served as an independent variable i.e. single predictor of achievements in this experiment</td>
</tr>
<tr>
<td>G</td>
<td>No. 5 was used as a tool in the pretest before the treatment</td>
</tr>
</tbody>
</table>

Experiment started

Fig. 7.
(iv) Methods of Controls:

Out of several methods for controlling variables the procedure suggested by Brown and Ghiselli was followed. Three types of controls had been advocated namely (i) physical manipulation, (ii) selective manipulation, and (iii) statistical manipulation.

The experimenter classified the variables into categories A, B, C, D, E, F and G that had been shown in the diagrammatic representation. Fig. No. ? .

(i) Variables Nos. 4, 6, 7, 8, 10, 17 fell under Gr. B.

(ii) Variables Nos. 1, 2, 3, 5, 9, 11, 12, 13, 14, 15 and 16 fell under Gr. C.

(iii) Variables Nos. 1, 2, 3, 9, 11, 12, 13, 14 and 15 fell under Gr. D.

(iv) Variables Nos. 5 and 16 fell under Gr. E.

Variable No. 16 was not controlled. This variable was made to vary to determine the extent of impact on the dependent variable. Variable No. 5 was treated as a pre-test for the analysis of co-variance.

From the above grouping of the independent variables it was apparent that very little effort might be rendered to control the variables falling under Gr. B. The experimenter could not control the physiological conditions (4), home conditions (17), school environment (10), study habits (8), and social and emotional adjustment (7). The controls of these areas were beyond the jurisdiction of the project undertaken by the experimenter. But with regard to the variable 'motivation for learning' (6) the experimenter being a common factor in teaching all the groups of the students, might develop same type of motivation.

The variables falling under Gr. D were to be controlled following different techniques of control.

A) The variables to be controlled by 'physical manipulation' were:

(a) time of study in school (11)
(b) size of the class (12)
(c) physical conditions of the classrooms (13)
(d) number of periods taught (14)
(e) content for the study (15)

1. For controlling 'time of study in school' efforts were made to select time during the school hours in such a way that all the classes of the experimental and the controlled groups got equal opportunity.
2. In controlling the 'size of the class' different sections of Class I were regrouped with equal numbers of students in a school.

3. In most of the primary schools 'physical conditions of the classrooms' were not congenial to studies. The classes were over-crowded. The students had no proper sitting accommodation. The blackboards were not placed in proper places. The classrooms were not ventilated. Attempts were made to eliminate the problems stated above as far as possible in cooperation with the students and teachers of the school.

4. The total number of periods to be devoted to teaching the content of text was fixed beforehand and the total periods in controlled and experimental situations were kept the same. Hence by constancy of conditions 'number of periods taught' was controlled.

5. To control 'the content for the study' was the primary need of the experimentation. Same content of the text was taught in both the experimental and controlled groups.

B) The variables falling under Group - D which were to be controlled by 'selective manipulation' were:
(a) Sex: The investigator chose primary schools for conducting experiment. Generally all the primary schools in West Bengal were co-educational. In each school the variable sex was controlled by selecting equal number of students for each group - controlled and experimental - and by keeping the ratio of boys and girls in each of the groups equal. The selection of the students of both the sexes was made by random sampling separately.

(b) Age: Ages of the students in a particular class of any school differed. In a class students of different age-groups read together. This variation in age was found greater in case of girls than in case of boys. But fortunately, number of such students in a class, belonging to the higher age-group were very little. These cases were eliminated at the time of statistical analysis in order to randomise into two groups (experimental and controlled) in respect of age. Variation of six months was allowed among the students.

(c) School environment: This variable was considered previously to be beyond the jurisdiction of the experimenter. But a portion of this variable was controlled by 'selective manipulation'. In each school students in Class I were grouped into two groups by random sampling - one for the experimental group and the other for the controlled group.
The remaining portion of the effect of school environment upon the achievement of the students (dependent variable) was controlled by the analysis of covariance in the form of M X S variance.

(d) **Teacher**: Teacher as a variable would cause a tremendous impact upon the dependent variable. If different teachers taught in different schools, or in the same school, the analysis of variance would provide an estimate of error due to teacher variable. So to eliminate this variable same teacher (i.e. the investigator himself) was engaged in teaching all the groups. The investigator himself was the teacher.

Here in this methods experiment an attempt was made to have an analysis of pooled results of duplicated experiments in schools of unequal size. In this experiment the interaction variance i.e. M X S variance was inevitable. Again number of students differed from one school to the other.

The students of Class I in each school were randomly selected for two groups. Identification of the two groups in each school as controlled group and experimental group was also randomly conducted.

In the experiment intelligence test score of a student was the initial measure (X). This test was administered on all the groups before the start of the experiment. The criterion measure (Y) was the score on diagnostic tests.
(designed previously by the experimenter) applied after the experiment was over. Since the students of the two groups in a school were not selected out of matched pairs they (groups) differed in means and standard deviations with regard to intelligence. In order to control this independent variable the method of analysis of covariance was adopted.

The two groups - controlled and experimental were designated as Group B and Group A in each school respectively. Conventional method and audio-visual methods and techniques were applied to Group B and Group A respectively. Here methods of teaching were such independent variables that were made to vary to see impact upon the dependent variable i.e. the criterion measure (Y).

(v) Determining the prerequisites for the experiment:

Before starting the actual experiment, the investigator assigned randomly all the students of Class I in each school into two groups - one for the controlled group and another the experimental group. Which group would become experimental or controlled was decided by randomization. The process of randomization indicated that the students under group A would be called experimental group and would be treated by the audio-visual methods and techniques, and those under group B would be called the controlled group and would be treated by the conventional approach.

The following points were borne in mind before the execution of experiments:
(1) The different groups in the schools were homogeneous in variability.

(ii) The true regression of final on initial class means' with methods and school differences eliminated, was the same from method to method.

(iii) The regression was linear.

Moreover, the content-areas remained the same in cases of experimental groups and the controlled groups. The following topics out of the total syllabus in arithmetic approved by the Director of Public Instruction, West Bengal were selected for studies for both the groups.

Topics: (i) addition, and
(ii) subtraction.

(vi) Application of an Intelligence Test:

While discussing the 'methods of control' of the independent variables, the investigator desired to utilise the intelligence test-scores as initial measure (X). The investigator used the Intelligence Test prepared by Dr. G. B. Kapat, Professor and Head of the Department of Education, Calcutta University.

Description of the Test:

Out of five batteries containing seventy five test items the investigator utilised four batteries containing

1. Appendix No. 1, pp. i - ii.
2. Appendix No. 17, pp. xxxiii - xxxviii.
sixty test items. The second battery was avoided due to some inconvenience of its duplication. Each battery contained specific direction and examples. Items in each battery were to be answered within the scheduled time-limit. The time-limit and the number of items for each battery were stated below:

<table>
<thead>
<tr>
<th>Battery</th>
<th>No.of Items</th>
<th>Time-limit</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>20</td>
<td>1 minute</td>
</tr>
<tr>
<td>3</td>
<td>18</td>
<td>3 minutes</td>
</tr>
<tr>
<td>4</td>
<td>12</td>
<td>1 minute</td>
</tr>
<tr>
<td>5</td>
<td>10</td>
<td>1 minute</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>60</strong></td>
<td></td>
</tr>
</tbody>
</table>

Administration of the Test:

The second period of the school was selected for administration of the Test. Generally, it was the suitable period for getting the students free from physical and mental tensions; and also the environment remained calm in that period. The investigator gave attention to them individually. He used the stop-watch for maintaining the time-limit for each battery.

Scoring of the Test:

The papers answered by the pupils in the Intelligence Test were scored according to the manual of the test. A full credit of '1' mark was credited to one item if answered correctly, and zero to the wrong, partially correct and no answer. Marks obtained by the individual student in all were summed up.
The scores obtained by the students in the Intelligence Test were tabulated.

(vii) Experimentation with the Controlled and Experimental Groups:

The methods experiment began on the ninth of January, 1978, basing upon the conditions stated before. It was extended up to the first March, 1978. Four weaker schools of Class I were selected. Out of these four schools two belonged to urban areas and two to rural areas.

The students in each school were randomly selected and were placed into two method groups. The placing of these two groups in methods was also done randomly. This was done to test whether there was any interaction between methods and schools.

The investigator chose second and third periods for teaching the groups in each school. The duration of each period was forty minutes. The content courses were divided in nine units which were taught in both the groups of each school. The detailed programmes in all the schools were stated.

1. Table No. 15, pp. 125-126.
2. Appendix No. 16, pp. xxix-xxxii
The investigator requested the heads of the institutions not to place any teacher in those classes for teaching arithmetic till the experiment was on. He also requested them to fulfill certain conditions, and help him in conducting the experiment in the months of January/February, 1978. The Teaching Units with which the experimental groups were taught were presented in Appendices Nos. 19-27.

(viii) Administration of Post-test and Evaluation of the Scripts:

The investigator administered the previously developed diagnostic tools in 'addition' and 'subtraction', in arithmetic within a week after the expiry of the 'experiment' on all the eight groups of students in four schools. He administered them on two days - first day for 'addition', and second day for 'subtraction'.

While evaluating the answer-scripts of the post-test the investigator adopted the following measures:

- The answer-scripts of the
- (a) students who were present in their classes throughout the whole period of experimentation only were taken into account for the presentation and analysis of the results.

1. Appendix No. 18, pp. xxxix-xl.
A few students could not come to school during experimentation because of their unavoidable circumstances in the household affairs, and a few were absent in some of the classes of the experimenter for their illness. The answer-scripts of the above categories of the students were excluded from the range of this analysis.

While examining the attendance registers of the students in different schools, separately maintained by the investigator, it was evident that in all one hundred twenty students were present on all the days in their classes during the period of experimentation. Their scores in the post-test (Y) together with their initial scores were shown in Table No. 15, pp. 125-126.

Thus the situation was ready for the presentation, analysis and interpretation of the data so obtained.