CHAPTER - III

METHODOLOGY

CONTENTS:

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METHODOLOGY

The purpose of the present study is to investigate the teaching competency of secondary school science teachers. An outline of the steps and techniques which were followed in conducting the research is given in this chapter. It contains in detail the design, samples, identification of science teaching competencies, rating scales, procedure of collecting data and the plan of analysis of data.

3.1 DESIGN OF THE STUDY:

The first phase of the study consists of the identification of science teaching competencies. The second phase of the study was the development of rating scales to evaluate those competencies. The third phase of the study consists of :-

(1) Sample of the Study; (2) Rating the science teachers by self, headmasters and pupils. The fourth phase of the study consists of interview of 30 competent science teachers rated by above process, and was to find out the relationship between competency and different attributes such as inherent capacity, environmental facilities, and academic background of teachers.

PHASE - I

3.2 IDENTIFICATION OF TEACHING COMPETENCIES;

3.2.1 Development of Competency List for the Study

The investigator tried to develop a list of teaching competency of a science teacher suitable to the perspective of teachers of Bangladesh. A draft of the list was prepared and sent it to different experts in the field of science teaching, and some teacher-educators those who are directly involved in teaching science, for collecting their opinions. That list consisted of 23 competencies which were grouped into five major areas of competency, viz., (I) Planning, (II) Presentation, (III) Apparatus and teaching aids, (IV) Laboratory Procedure, and (V) Evaluation.

The suggestions of those experts were carefully taken into consideration to modify the list of competencies earlier prepared by the investigator. A modified list of competencies of science teachers is given in subsequent pages. The initial grouping of competencies was also modified as suggested by the experts. The modified list of competencies consists of six groups instead of five and 30 competencies instead of 23 competencies as prepared by the investigator. The six major groups of competencies were:

(I) Competencies related to pre-instructional

(II) Competencies related to presentation of lesson

(III) Competencies related to develop interest, attitude and values

(IV) Competencies related to apparatus, chemicals and teaching-aids

(V) Competencies related to laboratory procedures and techniques

(VI) Competencies related to evaluation.

The modified list of competencies of a science teacher came into a final shape with number of competencies grouped into six major areas as given in the Table No.3.1.

TABLE NO.3.1   Distribution of Competencies under Six Functioning Areas.

GROUP	FUNCTIONING AREAS	NUMBER OF COMPETENCIES
I	Planning	7
II	Presentation	12
III	Attitude and Values	3
IV	Apparatus, Chemicals and Teaching-aids	2
V	Laboratory Procedure and Techniques	2
VI	Evaluation	4
	TOTAL	30

The competencies listed were then rated by different
experts , (viz.,secondary school science teachers ,college science
teachers, teacher educators and researchers) in a three points
rating scale as 'most important', 'important', and 'least
important'. The 'most important' competencies for the purpose
of this study implied that without this competency a teacher
could not be an effective teacher; an 'important' competency did
contribute to the effectiveness of a teacher but its absence did
not make him ineffective; the 'least important' competencies
neither increased nor discreased the effectiveness of the teacher.
The forms which were given for rating were collected from the
respondents after a convenient interval of time. The mean of the
response frequencies were then calculated. Analysing the mean of
the responses it was found that out of 30 listed competencies
none was considered as 'least important' by the respondents. 24
competencies were found to be considered as 'most important',
and 6 considered as 'important' for an effective teacher. Thus,
the identified 'most important' and the 'important' competencies
were considered for the final list of science teaching competency.
The response frequency and the mean value of each competency is
given in appendix A. The final list of science teaching compete-
ncies is given hereunder.

3.2.2 List of Science Teaching Competencies

Group:I   Competencies Related to Planning for Science Instruction

          1.   Selecting Content

2. Organizing Content.

3. Identifying and Stating Objectives.

4. Classifying Objectives according to domains.

5. Selecting appropriate Teaching Methods.

6. Choosing Teaching-Aids.

7. Structuring ways of Evaluation

Group:II Competencies Related to Presentation of Lesson

8. Introducing Lesson and sustaining attention.

9. Using Methods in Teaching of Science.

10. Explaining concepts and principles.

11. Asking Questions.

12. Increasing pupil participation.

13. Conducting lecture effectively.

14. Using Chalkboard

15. Demonstration

16. Organising and supervising field trips.

17. Giving homework and assignments.

18. Maintaining classroom discipline.

19. Closing the lesson.

Group:III Competencies Related to Develop Interest, Attitude and Values

20. Develop students interest towards Science.

21. Develop students attitude towards Science.

22. Develop students values towards Science.

Group:IV   Competencies Related to Equipment, Chemicals and
           Teaching - Aids

23. Using equipment, instrument and Chemicals.

24. Using Teaching - aids.

Group:V   Competencies Related to Laboratory Procedure and
           Techniques

25. Conducting Laboratory activities.

26. Maintaining Safety in the Laboratory.

Group:VI   Competencies Related to Evaluation

27. Developing different types of test items.

28. Classifying test items into domains.

29. Preparing results.

30. Using Results.

3.3 DEVELOPMENT OF SCIENCE TEACHER COMPETENCY EXPLORATIVE FORMS

30 competencies in six major areas were further
explorated for preparing the science teaching competency explora-
tive form (STCEF). For the development of STCEF the investigator
had to study deeply of relevant literature, educational books,
research reports, curriculum reports, Bangladesh Education Commi-
ssion Report etc. Moreover, the investigator contacted those
people who were directly associated with teaching. This preli-
minary draft was scrutinised for duplication, ambiguity and for
inculmination of irrelevant items and for addition of relevant
new items. Then each competency was sub-divided into different

components to give rise to STCEF (Appendix-B). The description of the six major areas consisting of 30 competencies and the subsequent competencies are described in the following paragraph.

3.3.1 Description of Six Major Areas of Competencies:-

Area-1 Planning: This is an important part of most human activities. In fact it is difficult to name any phase of our lives that does not involve at least some planning. In the classroom it seems that some teachers are better equipped than others to help the students in learning materials. In some classes, learning proceeded smoothly and was pointed toward the achievement of specific purposes; in other classes, little constructive activity took place and the students often left a lesson period without any clear idea of what the work was about. In other words, some of the teachers knew what they wanted to do and how to do it; others were not sufficiently prepared to guide learning activities. So, the successful teacher must have plan to his work that every one of his students benefits from participation with him in learning. So, it is the teacher who should know what learning activities need to be planned, why he includes, what he does in his teaching, and how the learning process can best be developed, term by term, week by week, and day by day. So planning plays a key role in effective teaching. This area of planning includes, selecting content; organizing content; identifying and stating objectives; classifying objectives;

selecting teaching methods; choosing teaching materials
and structuring ways of evaluation.

Area-2 Presentation of Lesson: An important area of
teaching is to acquaint with various teaching approaches
that can serve as effective means of stimulating successful
student learning. In the school the teachers have to
consider both teaching methods in general and those
techniques that are appropriate for the guidance of
learning in a particular subject. Teaching in the secondary
level is not limited to the process of guiding learning
in specific subject matter areas but he has to include the
various other activities that have educational implications
that can enhance learning outcomes. The proper conduct of
class routine, not only free the teacher and students of
teaching-learning activities but also help the students to
develop constructive work habits. This area includes
introduction of lesson; methods of teaching; techniques of
teaching and disciplinary teacher behaviours.

Area-3 Develop Interest, Attitude and Values: These
includes developing students interest towards science;
encouraging young pupils to develop desirable attitudes
towards science; and developing students' values towards
science.

Area-4 Equipment, Chemicals and Teaching-aids: These includes using of equipment, instruments, chemical and teaching-aids.

Area-5 Laboratory Procedure and Techniques: This area includes conducting laboratory activities and experiments, maintaining safety in the laboratory.

Area-6 The last area, Evaluation: This area includes evaluative behaviour of teachers; development of tests item; preparing results and using results for guidance of the students. The distribution of 120 sub-competencies under 30 competencies are given in the following table.

TABLE 3.2   Distribution of Sub-competencies under 30 Competencies.

Sr. No.	Competencies	Number of Sub - competencies.
GROUP: I		
1.	Selecting content	4
2.	Organizing content	3
3.	Identifying and stating objectives	5
4.	Classifying objectives into domains	3
5.	Selecting appropriate teaching methods	3
6.	Choosing teaching materials and teaching-aids	3
7.	Structuring ways of evaluation	3

Sl. No.	Competencies	Number of Sub-competencies.
GROUP: II		
8.	Introducing lesson and sustaining attention	6
9.	Using methods in teaching science	5
10.	Explaining concepts and principles	5
11.	Asking questions	6
12.	Increasing pupil participation	4
13.	Conducting lecture effectively	3
14.	Using chalkboard	3
15.	Demonstration	4
16.	Organizing and supervising field trips	3
17.	Giving homework and assignments	5
18.	Maintaining classroom discipline	5
19.	Closing the lesson	3
GROUP: III		
20.	Develop students interest towards science	3
21.	Develop students attitude towards science	4
22.	Develop students values towards science	4
GROUP: IV		
23.	Using equipment, instruments & chemicals	4
24.	Using teaching-aids	3
GROUP: V		
25.	Conducting laboratory activities	5
26.	Maintaining safety in the laboratory	4

Sr. No.	Competencies	Number of competencies.
GROUP: VI		
27.	Developing different types of test items	5
28.	Classifying test items into domains	3
29.	Preparing results	4
30.	Using results	3
	TOTAL	120

PHASE - II

3.4 RATING SCALE:

It is likely that no approach to the measurement of variables in research on teaching has been used more often than the rating method. Many of the variables in research on teaching are so complex that tests, questions and objectives behaviour records are either inadequate or too inconvénient. A rating scale as a measuring device is not only the paper form but rather the individual rater too. Hence, the rating scale differs in importance with respects to other forms of paper and pencil devices.

Elliott (1915) used structured rating scale to evaluate the teacher effectiveness. Barr (1929) selected good and poor teachers for his study on the basis of supervisory ratings.

Seyfert and Tyndal (1934) selected the best and poorest tea.. from seven general science teachers involved in Rulon's (1933) study, on the basis of superintendents, principles, and supervisors' observations. Binson (1937) ranked teachers from 1 to 25 on the basis of supervisors ratings made from 2 to 3 times each years for three years. Symonds (1954) describe how 32 teachers were ranked by their pupils and rated by the principal on a number of characteristics. Schultz (1955) selected the best and poorest teachers. He used team judgement of student - teachers' supervisors as selection criteria.

Rosenshine (1971) has summarised 21 investigations in which overall teacher competencies expressed in summated ratings, related to measured student achievement. In eight studies the teachers were only rated by the observers, in nine studies where students rating were used; and in four studies, the teacher was rated more than one source such as observers, students and peers.

Since, there is no single comprehensive aggreable criterion of teacher effectiveness (Gage 1972), hence, for this study it was decided to ask the headsof the schools, science teachers themselves, and pupils to rate their science teachers directly with the rating scale provided by the investigator.

3.5 DEVELOPMENT OF RATING SCALES:

The competencies thus, found out was subjected for rating of science teachers by the students, headmasters, and

the science teachers themselves. Three different forms were prepared by the investigator. The rating scales were exposed to a five point scale ranging from 'Always' 5; 'Often' 4; 'Sometimes' 3; 'Rarely' 2; and 'Never' 1. The scales were distributed amongst the sample described earlier for their rating.

3.5.1 Science Teacher Self-Evaluation Sheet (TSES)

The science teacher self-evaluation sheet was a rating scale prepared for the rating of science teachers' teaching competencies by themselves. 120 related components against 30 competencies under six areas were provided for the scale. The categories were in the form of self expression, and the teachers had to rate themselves upto what maximum degrees they were performing those activities within the frame of five point scale. (Appendix-C).

3.5.2 Science Teacher Evaluation Sheet (TES-H) (to be filled in by the head-masters)

This rating scale was to some degrees different from previous scale. The grouping, the number and the competencies itself were the same. All the 30 competencies used in the science teacher self-evaluation sheet were provided for developing this scale. In this scale the description of each category was provided in parenthesis below the principal category. The respondents had to write each teacher's name and the subject taught by the teacher in the space provided at the top of the sheet.

They were asked to rate the science teachers by crossing out the appropriate point within the frame of five point scale against each competency. (Appendix-D).

3.5.3 Science Teacher Evaluation Sheet (TES-P) (to be filled by the the pupils)

The evaluation sheet for rating the science teachers by the head-masters and the evaluation sheet for rating the science teachers by the students does not differ much except in category description. The same 30 competencies were used in both the scale. The only difference is that the scale (TES-P) was written in Bengali language. The description of each category was also provided in parenthesis. The pupil had to write each school's name, student's roll number and science teachers' name at the top of the sheet. To rate science teacher, the pupils were asked to cross the appropriate number in the respective column against each category within the frame work of five point scale. (Appendix-E).

3.6 RELIABILITY OF THE RATING SCALES

The reliability of the rating scale was calculated in three ways: (a) from science teacher self-rating; (b) from rating by the head-masters; and (c) from rating by the students. To determine the reliability of the rating scale, the mean of the rating score (M) and standard deviation (SD) of the test scores were calculated in respect of the entire sample as shown in the Table 3.3.

TABLE 3.3 Summarise Data on Self-rating by Science Teachers and
Ratings of Teachers by their Respective Head-masters
and Students.

Category of respondents	Number of respondents	Number of items in the scale	Highest possible score	Mean rating score (M)	Standard deviation of rating (SD)	Reliability coefficient (r)
Science Teacher Self	150	120	600	406.66	40.75	0.92
Head Masters	150	30	150	100.88	13.56	0.82
Students	150	30	150	100.32	14.38	0.84

The reliability of the rating scale for each category
of respondent was then calculated by using the approximation
formula of the method of Rational Equivalence as shown below:

$$r = \frac{ns^2 - M(n - M)}{(n - 1)s^2}$$ (81)*

* Kuder approximation formula

The reliability estimated by this formula was found
to be 0.92 for the teacher self-rating scale, 0.82 for head -
master's rating scale, and 0.84 for student's rating scale.
These reliability co-efficients are found to be positive and
high.

PHASE – III

3.7 SAMPLE:

The proper sampling in any study is intrinsic and leades to the success of the study. Studies in the area of teaching competency is not the exception to this. Efforts to evaluate teacher competency or prediction of teacher competency is the precondition of the involvement of the sample. Therefore a meticulous care has been taken in selecting the sample to conduct the field study of this research. The sample of the study included 212 science teachers of secondary schools of Dhaka city and 636 students of corresponding schools where from the science teachers were selected and 50 Head – masters from those schools.

3.8 THE FIELD STUDY:

For sampling, the investigator collected the list of secondary schools of Dhaka City. The list was prepared by Bangladesh Bureu of Educational Information and Statistics (BANBEIS), Ministry of Education, in the year 1988. According to the list the greater Dhaka City was divided into twelve thanas. The thana-wise distribution of secondary schools was shown in the table hereunder.

TABLE 3.4   Thana-wise Distribution of Secondary Schools of
Dhaka City.

Sr. No.	Thanas	Number of Non-Govt. Schools	Number of Govt. Schools
1.	Cantonment	14	
2.	Kotwali	7	
3.	Gulshan	15	
4.	Demra	18	
5.	Tejgow	10	
6.	Dhanmondi	12	
7.	Motijheel	24	
8.	Mirpur	19	
9.	Mohammadpur	9	
10.	Ramna	19	
11.	Lalbug	17	
12.	Sutrapur	13	
	TOTAL	177	24

Source: Bangladesh Bureau of Educational Information and
statistics (BANBEIS) Ministry of Education 1988.

According to the information furnished in the above
Table 3.4, there were 201 Secondary Schools in Dhaka City in
total. Among which 177 non-Government and 24 Government High
Schools. Twenty five percent of the total schools i.e. 50
schools were taken under this study. All science teachers of

these 50 schools were taken as the sample of the study. The way of selection of the schools were given in the following caption.

3.8.1 Selection of Schools

From the 201 secondary schools 50 schools were selected through stratified random sampling. Stratification of schools were done on the basis of schools standard. For this purpose the investigator collected the S.S.C. results of all the schools of Dhaka City for the year of 1987, 1988 and 1989, from the office of the Controller of the Board of Intermediate and Secondary Education, Dhaka. The results of the three consecutive years were then tabulated and the mean value of each school was calculated by counting the value for first class 3, for second class 2, for third class 1, and for failure 0. The mean value ranges from minimum to maximum standard of schools were 0.52 to 3.00. The schools were categorised from A to E on the basis of the mean value calculated against each school. Then 25 percent schools from each category were selected randomly for this study. The following table shows the stratified categories, the range of each category, and the number of schools in each category.

TABLE 3.5 The Range of Mean Scores and the Number of Schools against Each Category.

Category	Range of Mean Scores	Number of Schools
A	2.51 - 3.00	35
B	2.01 - 2.50	55

Category	Range of Mean Scores	Number of Schools
C	1.51 - 2.00	61
D	1.01 - 1.50	36
E	0.51 - 1.00	14
TOTAL		201

All the science teachers of the selected schools were the sample of the study. The list of selected schools and the number of science teachers working in each school is shown in the Appendix-F.

3.9 TOOLS:

The following tools were used for collection of data in the third phase of the study.

1. Teacher Self-Evaluation Sheet (TSES) (to be filled in by the science teachers)

2. Teacher Evaluation Sheet (TES-H) (to be filled in by the head-master)

3. Teacher Evaluation Sheet (TES-P) (to be filled in by the pupils).

All the tools were rated on a five point scale which is as under:

Never	Rarely	Sometimes	Often	Always
1	2	3	4	5

In the fourth phase of the study a 'Semi-Structured Interview Schedule' was used to take interview of thirty top most competent teachers.

3.10 DATA COLLECTION:

In accordence with the nature of data required and planning of the study, data were collected by different rating scales, viz.

(a) Teacher Self-Evaluation Sheet (TSES);

(b) Teacher Evaluation Sheet (TES-H), (filled in by the head master);

(c) Teacher Evaluation Sheet (TES-P) (filled in by the pupils).

As per the list of the selected schools the investigator himself went to those schools for collecting data. He met the science teachers of each school personally and made them understand, how to rate themselves. The researcher also met the headmasters, principals and the students of each selected school and made them understand, how to rate the science teachers by using the rating scale provided by the investigator. The number of science teachers, who taught science subjects in class IX and X of the selected schools were 212. To rate those science teachers the questionnaires were distributed at three levels i.e. science teacher self; the headmasters of those schools; and the selected students of class IX and X, those who were directly taught by the science teacher in the classroom. In this

way a total of 212 questionnaires for science teachers self-
rating, 212 questionnaires for head-masters' use and 636 ques-
tionnaires for students' use were administered for rating 212
science teachers. During data collection it was found that out
of 212 science teachers ten teachers were engaged in the post
of head-master; twenty five teachers refused to rate themselves
due to personal reason; and fifteen teachers were not found
available. So, ultimately 162 forms from science teachers, 187
forms from head-masters and 531 forms from students were colle-
cted. All the forms were then scrutinized and found that the
some forms used by the science teachers (self), some forms
used by the head-masters and some forms used by the students
were incomplete. So, the same were rejected. Finally, the
rating forms of 150 science teachers from three categories of
raters, viz., science teachers (self), head-masters and students,
were in complete state and were taken into consideration.

<div align="center">PHASE - IV</div>

3.11   INTERVIEW SCHEDULE:

The interview is perhaps the most ubiquitous method
of obtaining informations from people. It has been and still
used in all kinds of practical situation. Presently the inter-
view is being used systematically for scientific purposes. The
purposes of the interview are many. In this research the inter-
view of respondents were used as a suppliment to go deeper into
the problems and to find out the relationship between the compe-
tencies and different attributes such as teachers academic back-
ground, home and school environment. In this research for

collecting data, the investigator used the semi-structured inter-
view schedule which was prepared by the investigator himself.

3.12 DEVELOPMENT OF INTERVIEW SCHEDULE

The type of the interview schedule was a semi-structured
one. It consisted of fixed alternative items, open-ended items
and factual information including the sociological data i.e.,
respondent sex, marital status, education, income and the like.
The items which were entered into the biginning of the schedule,
was nutral in character and helped the investigator to establish
rapport with the respondents. Items of a more personal nature,
such as those about income and personal habits of the respondents,
preserved for later questions and are listed at the end of the
schedule. In this way a schedule containing different types of
items were developed by the investigator. For further develop-
ment the schedule was then given to some experts. They were
requested to pass their opinion regarding the items of the
schedule. On the basis of their opinion regarding the items
of the schedule, some modifications were made. In this way the
schedule came into its shape containing different types of items.
The items provided in the schedule were related to science
teachers' biographical information, academic background professional
qualification, experience, career advancement programme, home and
school environment, professional interest and job satisfaction.

3.12.1 Work-Ability of the Schedule:-

To see the work-ability of the schedule the investigator interviewed five science teachers of Dhaka University Laboratory School. During interview the investigator found some difficulties in case of few items which required detail information. Thus, some modifications were made to give the schedule the final shape.

3.12.2 Final Form of the Interview Schedule:-

The final form of the interview schedule came into being of 18 items of different types. Among them some items were regarding the factual informations of the teacher, and among the remaining, some fixed alternative items, some open-ended items and some scale items were included (Appendix-G).

3.12.3 Interview Technique:-

The investigator prepared the list of the target group, i.e., the thirty top most competent science teachers. Then he contacted them individually and prepared a time schedule for interview. Accordingly the investigator met the science teachers in their respective schools and interviewed the same in the light of the interview schedule and took necessary notes.

3.13 DATA ANALYSIS:

It has been discussed in the previous chapter about the advantages and the disadvantages of using the different methods to evaluate teacher effectiveness. Although, the rating is very

complex but it can be said that research on teacher effectiveness
still has not reached the stages of doing away with ratings. The
human raters are imperfectly reliable and often not highly valid
in his recorded judgement. Keeping in mind the said argument of
selection criteria in the present study, it has been done by
multiple ratings. The multiple rating criteria included the rating
of science teacher's self, rating by the heads of the institutions
and rating by the pupils. The concurrence ratings of the total
sample is shown in the appendix-H. In the appendix-H, the column
4, 5 and 6 represent teacher-wise concurrence ratings of respective
raters, i.e. the total self rating scores of individual science
teacher are shown in column 4, the total scores given by the
heads of the institutes are shown in column 5; and average
concurrence ratings of three pupils ratings are shown in column 6.
7th Column is the total concurrence of teachers' self-rating,
head-masters rating and the average rating of three students.
The numeral of 8th column indicates the teacher's status among
the list of 150 teachers on the basis of total scores. The data
analysis procedure involved in this study is given in several
places in the report.

1.   The rating scale used for rating the science teachers
      was developed on five point scale. The five categories
      were: always-5; often-4; sometimes-3; rarely-2;
      and never-1. The maximum probable ratings that one
      could have received was the number of categories on
      each teacher evaluation form multiplied by 5 (the

point value of always category). So, for self-rating
the maximum possible point was 600; for head-masters
rating the maximum possible point was 190; and for
pupils rating the maximum possible point was 190. On
the basis of total concurrence of three categories of
raters a list of 150 sampled science teachers under
this study was prepared by keeping the teacher who had
the highest point at the top, and who had the lowest
point at the bottom. From that list the top 30
teachers were selected for further study.

2. Analysis of sampled science teachers' competency on
the basis of self-rating: The means and the SDs were
calculated against each sub-competency and the aggre-
gate scores. Then the competency of the science teachers
and their distribution in the population were identified
and interpreted. To identify the degrees of intensity
of teachers' performance the Mean was used; to
identify the teachers' position in the distribution
against each competency or sub-competency, the value
of SD was used. When the value of SD was less than 1,
the group represented as homogeneous in respect of
that competency; and where the value of SD was 1 or
above, the group as a whole represented as hetero-
geneous in respect of that competency.

3. The test of significance (t) was then calculated to

find out the difference of ratings of three different groups of raters and their state of agreement regarding the science teachers' competency.

4. A profile of 30 top most competent science teachers were prepared in terms of their teaching competencies in graphic form. The graph shows the rating of three raters by three different form of lines.

Fig. 4.1.

5. Data collected through interview of 30 selected science teachers were analysed quantitatively. The co-efficient of correlation was found out to show the relationship between competency scores with different attributes of science teachers. The use of the analysis procedures and interpretations are presented in the preceeding chapter.