CHAPTER - III
METHODOLOGY

“Research designs are invented to enable the researcher to answer research questions as validly, objectively, accurately and economically as possible.”

– Fred N. Kerlinger

3.1 INTRODUCTION

The methodologies of educational research are based, in most instances, on research methods in the behavioural and social sciences emphasizing on Logical positivism which uses experimental and quantitative research methods. The research design is the overall plan; structure and the strategy of investigation to be carried out in the specific method of the research. It includes the outline, the scheme, and the paradigm of the operation of the variables, methods to be used to gather and analyze data.

This chapter deals with details of the activities of the research, methodology adopted for the study, measuring instruments to be used, individuals participating in the research, sample, how the experiment is conducted in the study, data collection and statistics used. The value of research can be raised by proper methodology.

3.2 METHOD OF THE STUDY

The investigator has used experimental method for this study. In Educational Research, Experimental method is the application and adaption of the classical method of the Science laboratory. It has been effectively applied within non-laboratory getting such as the classroom, where significant factors or variables can be controlled to some degree.
John W. Best (2004) describes it as, “Experimental research is the description and analysis of what will be or what will occur under carefully controlled conditions. Therefore, this method is the most sophisticated, exciting and powerful method for discovering and developing and an organized body of knowledge.

Here, experimental design is the blueprint of the procedure that enables the researcher to test the hypothesis by reaching valid conclusions about the relationship between independent and dependent variables. The experimenter has chosen the equivalent group for conducting the experiment.

3.2.1 TRUE EXPERIMENTAL DESIGNS

True experimental designs ensure internal validity as they provide for random assignment and control. It is rather very difficult to arrange for true experiments in the educational research, but wherever possible, true experiments should be undertaken.

3.2.2 RANDOMIZED - TWO GROUP - PRE-TEST-TREATMENT-POST TEST DESIGN

This design includes pre-test and post-test in the design. The gain scores of the members of the two groups may be compared for ascertaining the influence of the treatment over the dependent variable. The paradigm (model) of the design will be

\[ G_1 (E) P_1 T T P_0 T \]

\[ G_2 (C) P_1 T - P_0 T \]

The investigator used the pre-test-post-test control group design in this study. The control group and the experimental group were compared in all aspects. The control group was taken as the reference, which was used to compare
the experimental group. The control group was taught through the conventional method and the experimental group was exposed to the E-content.

3.3 IMPORTANCE OF RESEARCH DESIGN IN A STUDY

In any research, the research designs are deliberately and carefully conceptualized and executed to obtain accurate, valid and reliable results. The research designs which give an entire conceptual framework are considered to be the blueprint for the work to be carried out. The research design helps the investigator to obtain answers to the questions of the research and also helps to control the experimental, extraneous and error variances of the particular problem under study. Research design sets up the framework for “adequate” tests of the relations among the variables. It also gives an idea about what observations to be made and how to analyze the quantitative representations of the observations.

3.3.1 RESEARCH DESIGN OF THE STUDY

In order to promote the sensitivity for the experimentation, the investigator used the pre-test-post-test control group design in this study to assess the effectiveness of E-content in the Teaching of Mathematics Education (independent variable) on the enhancement of achievement of B.Ed. student-teachers (dependent variable). The control group and the experimental group were compared in all possible aspects. The control group was taken as the reference, which was used to evaluate the effectiveness of E-content in the Teaching of Mathematics Education for the experimental group. The control group was taught through the conventional method and the experimental group was exposed to the E-content.
Table – 3.1
Design of Experiment

<table>
<thead>
<tr>
<th>S. No</th>
<th>Control group</th>
<th>Experimental group</th>
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<tbody>
<tr>
<td>1</td>
<td>Pre-test</td>
<td>Pre-test</td>
</tr>
<tr>
<td>2</td>
<td>conventional method</td>
<td>E-content presentation method</td>
</tr>
<tr>
<td>3</td>
<td>Post-test</td>
<td>Post-test</td>
</tr>
</tbody>
</table>

3.4 EXPERIMENTAL DESIGN
3.5 PHASES OF THE STUDY

The design of the whole study is condensed and presented in a flow chart form:

Finalizing the Topic

Conceptual

Conceptualizing the variable

Operational

Reviewing

Content Selection

Development of E-content in the Teaching of Mathematics Education

Validation of E-content in the Teaching of Mathematics Education

Construction of Achievement test and Attitude Scale towards e-content in the Teaching of Mathematics Education

Validation of Achievement test and Attitude Scale towards e-content in Teaching of Mathematics Education

Setting experimental Design

Conventional method of teaching

Control Group

Experimental Group

Experimental method of teaching

Administration of Achievement test and Attitude Scale towards e-content in Teaching of Mathematics

Administration of Achievement test and Attitude Scale towards e-content in Teaching of Mathematics Education

Analysis and Interpretation of data

Finding the effectiveness of the E-content in the Teaching of Mathematics Education
3.6 POPULATION OF THE STUDY

Population of the study is the student-teachers of mathematics department of the colleges of education in Sivagangai district in Tamilnadu.

3.7 SAMPLE OF THE STUDY

The investigator has selected the sample as student-teachers of mathematics department of Alagappa University College of Education, Karaikudi and Sri Raaja Raajan College of Education, Karaikudi. From each of these colleges 30 student-teachers were selected to comprise the control group and experimental group of the study. These 30 student-teachers were selected using stratified random sampling technique. The control group and the experimental group subjects were equated in all possible aspects and thus facilitating parallel groups of the experimental designing.

After the experimental process, the control group as well as experimental group were assessed for the knowledge in the methods of Teaching Mathematics and the attitude towards e-content in Teaching of Mathematics Education.

Finally the post-test was conducted for the control and the experimental group to find the efficiency of the e-content in the Teaching of Mathematics Education.

3.8 RESEARCH TOOLS

The present study used the following tools:

1. E-content in Teaching of Mathematics Education.
2. Attitude towards E-content in Teaching of Mathematics Education.
3. Achievement Test prepared and standardized by the investigator.
3.8.1 DEVELOPMENT OF E-CONTENT IN TEACHING OF MATHEMATICS EDUCATION

The main objective of the study is to develop E-content in the Teaching of Mathematics Education for the B.Ed. student-teachers. The investigator has selected one unit from the paper ‘Teaching of Mathematics Education’ namely Methods of Teaching Mathematics. This unit was divided into ten meaningful modules according to the content. The modules selected for the study are furnished in the following table.

Table – 3.2

<table>
<thead>
<tr>
<th>Modules in E-content in Teaching of Mathematics Education</th>
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<tbody>
<tr>
<td><strong>S.No.</strong></td>
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</tbody>
</table>
|   |   | 7. Example-2  
|   |   | 8. Example-3  
|   |   | 9. Some more examples  
|   |   | 10. Merits  
|   |   | 11. Demerits  
|   |   | 12. Comparison  
|   |   | 13. Quiz  
|3 | Analytic Method | 1. Introduction  
|   |   | 2. Objectives  
|   |   | 3. Meaning  
|   |   | 4. Example-1  
|   |   | 5. Example-2  
|   |   | 6. Merits  
|   |   | 7. Demerits  
|   |   | 8. Quiz  
|4 | Synthetic Method | 1. Introduction  
|   |   | 2. Objectives  
|   |   | 3. Meaning  
|   |   | 4. Example-1  
|   |   | 5. Example-2  
|   |   | 6. Merits  
|   |   | 7. Demerits  
|   |   | 8. Comparison  
|   |   | 9. Quiz  
|5 | Lecture Method | 1. Introduction  
|   |   | 2. Objectives  
|   |   | 3. Guidelines for Preparing Lecture  
|   |   | 4. Example  
|   |   | 5. Applicability  
|   |   | 6. Merits  

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|   | Laboratory Method | 1. Introduction  
|   |                 | 2. Objectives  
|   |                 | 3. Example-1  
|   |                 | 4. Example-2  
|   |                 | 5. Some Sample Topics  
|   |                 | 6. Merits  
|   |                 | 7. Demerits  
|   |                 | 8. Quiz  
| 7 | Heuristic Method | 1. Introduction  
|   |                 | 2. Objectives  
|   |                 | 3. Primary Objectives of the method  
|   |                 | 4. Essential Conditions for Heuristic learning  
|   |                 | 5. Example  
|   |                 | 6. Merits  
|   |                 | 7. Demerits  
|   |                 | 8. Quiz  
| 8 | Project Method | 1. Introduction  
|   |                 | 2. Objectives  
|   |                 | 3. Steps  
|   |                 | 4. Criteria for a good project  
|   |                 | 5. Role of the teacher  
|   |                 | 6. Some projects  
|   |                 | 7. Example  
|   |                 | 8. Merits  
|   |                 | 9. Demerits  
|   |                 | 10. Quiz  

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The steps followed during the development of the E-content in Teaching of the Mathematics Education are as follows:

i. Framing Objectives
ii. Planning
iii. Production
iv. Programming and
v. Evaluation

The steps are illustrated in the following figure.
Development of E-content

Start

Target analysis

Content analysis & presentation

References

Type of computer

Flow charting

Content accuracy

Framing objectives

Planning

Production

Programming

Evaluation

Stop

Teaching support

Finance

Software analysis

Storyboarding

Text

Incorporation of colour diagram

Graphics and animation

Audio & video
3.8.1.1 FRAMING OBJECTIVES

Framing objectives for the development of E-content in the Teaching of Mathematics Education was an important step. All the objectives had to be in behavioural and measurable terms.

3.8.1.2 PLANNING

Planning was the most important phase which included the following items:

i. **Target analysis**

   It was essential to consider the level of the student-teachers; the entry behaviour required, gender, attitude towards E-content in the Teaching of Mathematics Education, cultural background and the knowledge of using the E-content. During the target analysis, the suggestions given by Usha V.Reddy and Sanjave Mishra (2003) were followed.

ii. **Content analysis and presentation**

   The investigator chose one unit (methods of teaching mathematics) from the optional-I paper ‘Teaching of Mathematics Education’ prescribed by the Alagappa University on the basis of expert opinions. It was realized that the new scenario demands new professionalism on the part of the teachers. The new teacher education and training should not lose site of the power of technology for both the teachers and the students learning. The teacher education system empowered technology driven infrastructure that can have a great opportunity to come up to the centre stage and ensure academic excellence, quality instruction and leadership in a knowledge-based society. The investigator, with the help of senior professors and other experts, divided each chapter into meaningful lessons. The investigator also indentified the needs of the student-teachers and arranged the content in the order, from simple to complex. In order to give the best
presentation possible, the investigator incorporated still pictures, animation, video, video-text, narration, graphics and quiz.

iii. **Type of computer**

The type of computer utilized for the newly developed E-content in Teaching of Mathematics Education for the B.Ed. student-teachers should be identified. It may be operated with the help of windows based system. The investigator has used the Lenovo computer with windows based system for the present study.

iv. **Technical support**

For the development of the E-content in the Teaching of Mathematics Education for the B.Ed. student-teachers, the support of expert persons in the field of computer science with knowledge in articulate software is essential. Hence, the necessary technical support for the experts in the field of computer science was adopted. Being an experienced Mathematics teacher-educator with adequate experience in the teaching of Mathematics education to student-teachers, the investigator acted as the instructional designer for the E-content in the Teaching of Mathematics Education.

v. **Finance**

Investment is one of the basic criteria for the development of any kind of E-content. Out of the researcher’s own funds, the investigator developed this E-content in the Teaching of Mathematics Education for the B.Ed. student-teachers.

vi. **Software Analysis**

Based on the consultation with software Engineers and technical assistants, the most suitable software should be chosen to develop an e-content. For the
present investigation, the investigator selected the following software as per the suggestions given by the experts.

1. Articulate storyline
2. Articulate Studio
3. Audacity 1.3
4. Adobe Flash Professional CS5.5
5. Window Movie maker

3.8.1.3 PRODUCTION

Based on the above meticulous planning, the E-content in the Teaching of Mathematics Education was developed phase-wise.

1. Home Page

It is a guide to any learner who operates the E-content in the Teaching of Mathematics Education. Before starting production, a well-established flow chart is essential. It shows a product which starts with a title screen and a main menu screen. For the newly developed E-content, a well-established flow chart was developed. The newly developed E-content starts with the home page opening program and the menu list on the left side of the screen and by using the mouse, the learner can choose the module that they have to learn. By choosing the first topic, the learner can go about any lesson related to the topic.

2. Content accuracy

Content accuracy is indispensable for the development of E-content in the Teaching of Mathematics Education. Script writing, narration, graphics and animation are based on the accuracy of the content. The content was taken from the Alagappa University Optional-I ‘Teaching of Mathematics Education’ syllabus prescribed for the B.Ed., degree Course. The content selected for the newly developed e-content is accurate.
3. **Scripting**

A meaningful lesson was developed with good scripting. This was possible with the help of Mathematics Education experts and software technical assistants. This script was written by the investigator with the help of requirements. It has been found that the contents included in the text are accurate.

4. **Story boarding**

A story board is simply a hand-drawn visualization of every scene that is to be shot. It combines the information from the script and flowcharts into a visual hard copy. A story board is critical to maintain visual and narrative continuity from one scene to the next. In the present study, the investigator drew the story board, and it was given to the technical experts.

5. **Text**

In the newly developed e-content, the text is kept concise, informative and interesting. The contents are written concisely so as to convey the meaning and full information to the learner. In some places, presentation of the text is done through animation. A variety of methods were used to animate the text.

6. **Incorporation of Colour Diagram**

Colourful diagrams can capture the attention of the learner better than black and white diagrams. So the investigator carefully collected colour diagrams from various sources, and everything was incorporated in the E-content in Teaching of Mathematics Education.

7. **Graphics and Animation**

Graphics and animation are the highlights of the E-content in the Teaching of Mathematics Education preparation. Static objects cannot capture attention and sustain interest always. But it is possible with graphic and animated images. The
present e-content development used more graphics and animation in order to give more accurate knowledge and experience.

8. **Audio and Video**

   Among the five senses, hearing plays a vital role in the field of teaching and learning. So, it was realized that each slide with a textual message had to be supplemented with the audio features. The audio file is included in appropriate places, wherever it is necessary. Video is a powerful communication tool. The video files containing both sound and moving pictures take up a lot of space, and hence, the investigator used short video clips in the e-content.

3.8.1.4 **PROGRAMMING**

   During the programming stage, the investigator determined how well the flow chart and the interface design worked. The screen design was developed by technical supporters. This input gave the e-content a professional look. The ‘on screen’ buttons for movements through the Programme can be easily identified and found on the same screen. The method of interaction is similar throughout the e-content. The screen supplies the user with all the information needed to navigate through and to interact with the Programme.

3.8.1.5 **EVALUATION**

   Evaluation of the E-content in Teaching of Mathematics Education can be done at two levels; one is at the level of content and the other is the level of the technology employed. In the present investigation, once the entire content of the Programme was developed, a test e-content was created. This e-content was passed to various content specialists together with a sampling of the target evidence for feedback and evaluation. The e-content was tested for content accuracy, ease of use and appeal. A time limit was set for this evaluation phase based on the comments, corrections were made.
The lesson, thus developed, was done to ensure accuracy and relevance of the material, style, vocabulary and content interest. This eliminated ambiguities, obscurities and other inadequacies and brought about technical accuracy of the content presentation. For proper editing of the lessons, the services of colleagues and subject experts in the respective disciplines were utilized.

After the editing, the lessons were ready for preliminary tryouts. Tryout is an essential process of validation, and it helps in refining the lesson and makes it relevant to the target population. The E-content in Teaching of Mathematics Education was given for individual try out and group try out of 30 students. This gave the researcher an opportunity to study the feedback of the learners with reference to the content presented. So, on the basis of the preliminary try out, necessary corrections, modifications, additions, deletion and refinements were made. Then the E-content in Teaching of Mathematics Education was given to subject experts for their opinion and comments. On the basis of the experts’ opinions, the final draft of the E-content in Teaching of Mathematics Education was applied to the experimental group. A softcopy of the newly developed E-content in Teaching of Mathematics Education is enclosed in the thesis. (Appendix)

**3.8.1.6 REQUIREMENTS OF THE SYSTEM TO LOG ON**

The following software are used in the E-content in Teaching of Mathematics Education.

- Articulate storyline
- Articulate Studio
- Audacity 1.3
- Adobe Flash Professional CS5.5
- Window Movie maker
The hardware configuration used to design the E-content in Teaching of Mathematics Education:

Processor : Pentium IV
Speed : 1.7GHz
RAM : 1 GB
Hard Disk Drive : 240 GB
Operating System : Windows XP
Visual Display Unit : SVGA Color
Keyboard : 110 Keys
Mouse : 3 Keys Multi Scroll
Printer : HP Laser Jet
CD-ROM : CD RW 52-32-52X
Graphics : Active Movie Control Card
Color : 64 Bit Color Card
Resolution : 1024 x 7768
Integrator : Multimedia Kit

The minimum hardware requirements to install this E-content in Teaching of Mathematics Education at the B.Ed., level on a standalone computer is

- Windows XP or superior
- Pentium 4 processor at 400 MHz or higher
- 512 MB RAM
- GB available in the hard disk
- CD-ROM, 2x or higher
- Direct X 3.0 or higher
• SVGA color VDU
• Multimedia Kit

3.8.1.7 INSTALLATION

For the installation of the E-content the following procedures have to be considered.

• Install ‘Shock wave player’ (or) ‘Flash player 10’
• Insert disc in the CD-ROM drive.
• Just Click on ‘Story.html’

3.8.1.8 FEATURES OF E-CONTENT IN TEACHING OF MATHEMATICS EDUCATION

• E-content in Teaching of Mathematics Education is user friendly in nature.
• Every lesson has objectives to be attained, introduction to content; relevant content, the examples are highlighted and a quiz to check the progress.
• Relevant pictures, videos and animation add a colorful meaning to the content.
• Voice is added in every frame to scintillate the senses of the students.
• Navigation buttons are clearly shown so that the user can use it as per their requirements.

3.8.2 DEVELOPMENT OF ACHIEVEMENT TEST

The achievement test was developed as per the instructions of Stanley and Hopkins (1972) such as:
a. Provision should be made for evaluating all important outcomes of the instruction.

b. Nature of the test must reflect its purpose and

c. The nature of the test must reflect the conditions under which it would be administered.

The development of the Achievement Test was based on the following sources.

(i) **Item selection**

For the present investigation, the investigator consulted experienced Mathematics teacher-educators to construct the achievement test. Based on the experts’ opinion, a rough draft of the tool was prepared. This rough draft was again presented to the experts for structuring and revision of the items. Garret (1979) called this stage as the item selection stage.

The item includes 50 multiple choices questions.

Ebel (1963) has given some suggestions to be followed in framing Multiple-choice items. They are as follows:

a. Before writing the items, make an explicit statement of the idea, the items will embody. Select key statements, especially those which clearly define the concepts and principles, from good instructional material.

b. Write the item in the way which will allow greater success for those learners who have achieved greater mastery of terminal behavior than those learners who have achieved less mastery.

c. Prepare the original draft in such a way as to make revision and assembly convenient.
d. Write the items clearly, simply and correctly as possible.

e. Make a distracter thoroughly wrong and yet plausible to the learners who know a little but not enough. Victor Noll (1965) identified how distracters can vary from being plausible to being absurd.

f. Make the correct answer thoroughly correct, express it clearly and avoid specific determiners, which will betray the answers to all the alert but unknowledgeable learners.

g. Modify the item, if necessary, so that 50 percent of the learners will answer correctly.

h. Arrange for a colleague to review the original draft. The reviewer should try to answer each question and should check his choices against the answer key.

These suggestions were carefully followed while developing the achievement test.

(ii) **Item Analysis:** All the selected (55) items were tabulated under the Achievement Test. The investigator chose 30 B.Ed student-teachers from Alagappa University College of Education for administering the Achievement Test. The scores for each question was computed and tabulated. And the final items (50) for the study were selected using SPSS package (Cronback’s Alpha).

**3.8.2.1 RELIABILITY OF THE ACHIEVEMENT TEST**

‘Reliability is consistency with which a tool measures what it measures’ (Garret, 1979). A test is reliable to the extent that it measurers accurately and consistently from one time to another.
3.8.2.2 INTERNAL CONSISTENCY METHOD

Reliability analysis allows the researcher to determine the extent to which a scale produces consistent results if the measurements are repeated. Cronbach’s alpha increases as the inter-correlations among the items included in the analysis increase.

INTERPRETING ALPHA

A general rule for measuring reliability in cronbach’s alpha statistics is alpha above 0.70 and it is considered reliable. Alpha above 0.60 is probably reliable. Alpha below 0.59 considered not reliable.

The reliability of the achievement test is 0.80 which is high enough to establish the reliability.

3.8.2.3 VALIDATION OF ACHIEVEMENT TEST

Validity of a test refers to the test’s quality to measure what it intended to measure, that is, “the degree to which the test actually succeeds in measuring what it sets out to measure is called its validity”. In the words of Gates, “A test is valid when it measures truly and accurately the ability (or) quality one wants to appraise”. Thus validity means truthfulness of the test. In this test the investigator tried two types to establish the validity of the achievement test. They are:

i) Face validity

This means that the given test appears (or) seems to measure what it is to measure. If the relevant content appeared in the particular area, then the test has face validity. In this regard, the present achievement test has covered the relevant content in the particular areas of teaching methods. Hence face validity was established.
**ii) Concurrent Validity**

It is used to indicate the validity of the new test by correlating it with some present source of information. This source of information might have been obtained shortly before (or) very shortly after the new test was given. The achievement test scores were correlated with the first model examination scores in Mathematics. The calculated coefficient was 0.82 and thus the concurrent validity was established.

### 3.8.3 CONSTRUCTION OF THE ATTITUDE SCALE TOWARDS E-CONTENT IN TEACHING OF MATHEMATICS EDUCATION

Attitude scale towards E-content in Teaching of Mathematics Education was developed by the investigator in order to assess the attitude towards the e-content of the B.Ed student-teachers before and after treatment.

The tool was developed based on three phases.

(i) Pre-pilot phase
(ii) pilot phase and
(iii) finalization phase

**(i) Pre-Pilot Phase**

Pre-Pilot phase is concerned with item pooling. It consists of a) item coverage b) source of items and c) Criteria for item selection.

**a) Item Coverage**

The Attitude scale towards E-content in Teaching of Mathematics Education covered the following areas:

(i) Efficacy (feelings of competence in using e-content)
(ii) Comfort (feelings of comfort with e-content)
(iii) Interest (the extent to which one is interested in learning through e-content)
(iv) Dehumanization (the belief that learning through e-content is dehumanizing)
(v) Utility (the belief that learning through e-content is useful)
(vi) E-content accessibility

b) Sources of the Items:

i Discussion with experienced computer experts.
ii Discussion with experienced educational psychologists.
iii Discussion with learners.
iv Discussion with educational experts and
t Review of thematic and research work.

By careful analysis of the above sources, statements were collected and tabulated. Thus a total of fifty five items were gathered during this stage.

c) Criteria for selection of the Items

The collected statements were not directly administered, but they were subjected to screening. The following criteria were deleted, added, revised etc.,

i) The language of the statement should be simple, concise and unambiguous
ii) The rater should clearly know that it is rating
iii) The direction should be clear for honest rating
iv) Each and every statement should be short
v) The statements that are likely to be endorsed by almost every one or no one should be avoided.
(ii) Pilot Study Phase

The Pilot study is concerned with screening the items selected during the pre-pilot study. The re-selection of the items was done on the basis of two levels (a) Judgment Analysis, (b) Item Analysis.

(a) Judgment Analysis: All the selected items are again given to the subject experts to determine the suitability and objectivity of the items pooled. It has been sent to the jury council. It consists of 3 faculty members from Alagappa University College of Education. On the basis of the Jury Council’s judgment, some items were deleted and some were restructured.

(b) Item Analysis: All the selected (55) items were tabulated under the Attitude Scale towards E-content in Teaching of Mathematics Education. The investigator chose 30 B.Ed student-teachers from Alagappa University College of Education for administering the Attitude Scale towards E-content in Teaching of Mathematics Education. The scores for each respondent was computed and tabulated. And the final items for the study were selected using SPSS package (Cronback’s Alpha).

(iii) Finalization Phase

By using item Analysis 45 items were finally retained in the Attitude Scale towards E-content in Teaching of Mathematics Education.

SCORING PROCEDURE

The Attitude Scale towards E-content in Teaching of Mathematics Education consists of 45 test items. Each one is unique and has four options – A-Strongly Agree, B-Agree, C-Disagree, D-Strongly Disagree. The scale consists of both positive and negative statements. There are 23 positive statements (S.No. 1, 2, 4, 5, 6, 8, 10, 12, 14, 16, 18, 20, 22, 24, 26, 28, 29, 31, 33, 35, 38, 41, 42) and 22 Negative statements (S.No. 3, 7, 9, 11, 13, 15, 17, 19, 21, 23, 25, 27, 30, 32,
The subject has to choose any one of the four options as his answer. The questionnaire is used for testing the student-teachers’ attitude towards E-content in Teaching of Mathematics Education.

### Table – 3.3
**Scoring Key for Attitude Scale**

<table>
<thead>
<tr>
<th>Scale</th>
<th>Strongly Agree</th>
<th>Agree</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
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<tbody>
<tr>
<td>Rating for positive statement</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Rating for negative statement</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
</tbody>
</table>

3.8.3.1 **RELIABILITY OF THE ATTITUDE SCALE TOWARDS E-CONTENT IN TEACHING OF MATHEMATICS EDUCATION**

It measures the inter correlation of the items with the test as a whole. Reliability analysis allows the researcher to determine the extent to which a scale produces consistent results if the measurements are repeated. Cronbach’s alphas are statistic used to determine the internal consistency, so Cronbach’s alpha increases as the inter-correlations among the items included in the analysis increase.

**INTERPRETING ALPHA**

A general rule for measuring reliability in cronbach’s alpha statistics is alpha above 0.70 is considered reliable. Alpha above 0.60 is probably reliable. Alpha below 0.59 is considered not reliable.

The reliability of the achievement test is 0.83 which is high enough to establish the reliable.
3.8.3.2 VALIDITY OF ATTITUDE SCALE TOWARDS E-CONTENT IN TEACHING OF MATHEMATICS EDUCATION

Validity of a test refers to the test’s quality to measure what it intended to measure, that is, “the degree to which the test actually succeeds in measuring what it sets out to measure is called its validity”. In the words of Gates, “A test is valid when it measures truly and accurately the ability (or) quality one wants to appraise”. Thus validity means truthfulness of the test. In this test the investigator tried two types of validity to establish the validity of the attitude scale towards e-content in teaching of mathematics education. They are:

i) **Face validity**

This means that the given test appears (or) seems to measure what it is to measure. The attitude scale towards e-content in teaching of mathematics education is used for the study of the relevant content that is attitude of the B.Ed student-teachers towards e-content in teaching of mathematics education and hence face validity was established.

ii) **Content Validity**

It is a type of test validity in which the content of the test is judged to be representative of a large domain of the content. The content validity can be ensured by the systematic plan and procedures of assessment construction. After a careful analysis, the six major dimensions namely: Efficacy (feelings of competence in using e-content), Comfort (feelings of comfort with e-content), Interest (the extent to which one is interested in learning through e-content), Dehumanization (the belief that learning through e-content is dehumanizing), Utility (the belief that learning through e-content is useful) and E-content accessibility are judged to be representative of a large domain of the content in the attitude scale towards e-content in teaching of mathematics education. Thus the content validity was established.
The format of the Attitude Toward is shown in Table No.3.3

**Table – 3.4**

*Format of Attitude Scale towards E-Content in Teaching of Mathematics Education*

<table>
<thead>
<tr>
<th>S.No</th>
<th>Items</th>
<th>Strongly Agree</th>
<th>Agree</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>E-content in teaching of Mathematics Education enhances the teaching-learning process.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td>E-content in teaching of Mathematics Education makes the student-teachers feel more involved in their lesson.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>45</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The item analysis eliminated 11 items from the 56 items. So at the end only 45 items were retained in the Attitude towards Computer Scale. The final draft of the Attitude Scale towards E-content in Teaching of Mathematics Education is shown in the Appendix I.
3.8.4 ADMINISTRATION OF THE ATTITUDE SCALE TOWARDS E-CONTENT IN TEACHING OF MATHEMATICS EDUCATION

The Attitude Scale towards E-content in Teaching of Mathematics Education was administered to the control and the experimental groups during the pre-treatment and the post treatment period to know the level of attitude towards E-content in Teaching of Mathematics Education. A good rapport was maintained with the B.Ed. student-teachers. No time limit was fixed to complete the Attitude Scale. The queries, doubts and clarification were cleared then and there by the investigator.

3.8.5 ADMINISTRATION OF THE ACHIEVEMENT TEST

The Achievement test was administered as a pre-test and post-test to the B.Ed. student-teachers of both the control group and the experimental group. This was to assess their entry behavior and the effectiveness of E-content in Teaching of Mathematics Education. The duration of the test was one and half hours.

3.9 CONTROLLING THE VARIABLES DURING THE PRE-TEST

The intervening variable has to be controlled. In this study all the subjects in the sample were treated equally. The time variable was controlled by giving equal time limit to all the participants.

3.10 CONTROLLING THE VARIABLE DURING TRAINING PROGRAMME ADMINISTRATION

The most important activity in experimentation is to control the variable that threatens the validity of the experiment. Failure to keep within the limit of such variables will definitely affect the outcome of the results. Comp Bell and Stanley list two types of validity-internal and external validity. In the present study, all efforts were made in controlling the threats that would affect the internal and external validity of the experiment.
### 3.11 CONTROLLING OF THREATS TO INTERNAL VALIDITY OF THE EXPERIMENT


**1) Testing**

The process of pretesting at the beginning of an experiment can produce a change in the subjects. Pretesting may produce a practice effect making the subjects more proficient in subsequent test performance. Testing presents a threat to internal validity that is common to pre-test, post-test experiments.

This was eliminated in the study by having a control group and this was also controlled by statistical treatment.

**2) History**

Specific external occurring between the first and second measurements and beyond the control of the researcher may have a stimulating or disturbing effect on the performance of the subjects.

The threat due to this was minimized in the study by providing the same condition and settings to both the group except for the treatment. Moreover no specific noticeable instances did happen during the experiment to affect either of the group.

**3) Statistical Regression**

Statistical regression, also known as regression to the mean, is a phenomenon that sometimes operates when the subjects are selected on the basis of extremely high or extremely low pretest scores and when the measurement device is not totally reliable, a situation which is common.
Statistical Regression was controlled by equalizing the experimental and controlled group in all respects (i.e) homogeneity of group existed.

(4) Experimental Mortality

Experimental mortality includes the “loss” of the subjects during the experiment. Because of illness, family relocation, or the requirement of other activities, some subjects may drop out of the study.

In the present study experimental mortality was arrested to the maximum possible way so that the subjects were not lost in anyway.

(5) Selection Bias

Selection bias is a threat to the internal validity in which differences between the groups of subjects affect results. Section bias is represented by non-equivalence of experimental and control groups, and its most effective deterrent is the random assignment of treatments to the subjects (Best, 1977). The threat of selection exists whenever groups of subjects cannot be randomly assigned. Selection is also related to the manner in which the researcher chooses a sample which would affect the study.

In the present study, selection bias was controlled by selecting the subject to the groups by the randomization process. In randomization, each and every individual in the experiment has an equal chance of being assigned to experimental or control groups which are compared. The control group and the experimental group were compared carefully with respect to gender, age, attitude towards e-content and previous knowledge.

(6) Instrumentation

Unreliable instruments or techniques used to describe and measure the aspect of behavior are instrumentation which includes (I) Instrument decay (II)
Data Collector’s Characteristics and (III) Data collector’s Bias. Checking the threats to the validity of the experiment and the stability of the tool are essential to reach a valid result.

(I)  *Instrument decay* is a natural phenomenon changed in some way or other. This is a case which permits different types of interpretations of results. In the present study, the investigators excluded essay questions and produced objective type questions and two mark questions which could control instrument decay.

(II) *Data Collector’s Characteristic* is another threat to the internal validity factors such as gender, age, ethnicity, and language influence might affect the nature of the data. The investigator personally collected the data so as to check the threat.

(III) *Data Collector’s Bias* arises when the data collector’s scores distort the data in a way as to make certain outcomes such as to support the hypothesis. In the present study, no manipulation was made to support the formulation hypothesis hence, objectivity was established.

In the study, the newly developed E-content in Teaching of Mathematics Education has been used. So probably there is no chance of expecting any error in the programme. In case of mechanical error it was immediately rectified by the investigator. In the present study the reliability and validity of the tool was established and hence stability of the instrument was ensured.

*(7) Diffusion of Treatment*

It is also internal validity threat to the study. It is possible in a study whenever there is an exchange of ideas between the experimental and control groups of students among themselves during the study. In such cases, the treatments are diffused throughout all subjects which intern affects the result.
Usually when any two groups are treated differently, there is always a possibility of inferiority complex development among the groups. As McMillan and Schumacher (1984) maintain, diffusion of treatment may result in resentment or rivalry of one group, especially of the group members who perceive that they have had inferior treatment or activity.

In this study diffusion of treatment was controlled as equal status was uniformly given to both the groups and moreover the trainees were selected from two different colleges.

(8) **Experiment Bias**

This type of bias is reflected in differential treatments of subjects such as using a different voice tone, being more reassuring to one group than to another, reinforcing different behavior, using different attitudes, and other influences such as either the subject’s behavior or the evaluation by the investigator. Here, by giving equal status, this threat was avoided.

(9) **Statistical Conclusions**

The regulations of the statistical should be strictly followed whenever any statistical calculations are carried out. But sometimes there is a possibility of making mistakes in the statistical work. It comes as a statistical threat to the study. In the study with the aid of experts’ opinions and careful ways of doing calculation, this threat was avoided to the maximum.

### 3.12 CONTROLLING OF THREATS TO EXTERNAL VALIDITY

The factors to be considered affect the extent to which the results of the study can be generalized to other situations, other populations, other tasks, and other measures. The common threats to external validity are (1) location (2) Representation (3) Reactive effects of testing (4) Reactive effect of experimental
procedures (5) Multiple treatment interference and (6) Intersection of selection and the experimental variable.

(1) Locations

The particular location in which data are collected may create alternative explanation for results. This is termed as ‘location threat’. The performance of the learners may be lower if the tests are given in noisy or poorly lighted rooms. But in this study, a well established two colleges have been chosen to avoid all location threats.

(2) Representativeness

The critical consideration in assessing external validity is the degree to which the sample is representative of the population to which the results of the study are to be applied. In this study the population and sample were randomly chosen from the Mathematics students of B.Ed., Colleges. Thus the selected group was the representative group of population.

(3) Reactive Effective of Pre-testing

In an experiment, there is a danger that the pre-test may affect the responsiveness of the experimental group to the treatment. It is observed that a pre-test measuring knowledge about the study may sensitize the subjects and as a result, they may be more responsive to the information given during the treatment period. In order to avoid this kind of sensitization, the test was conducted as a regular class test to both the control and experimental groups.

(4) Reactive effects of the experimental procedures

In experimental research, there is a possibility for the interaction of experimental procedures and the treatment may produce an effect. This is often alluded to as the ‘Hawthorne effect’. It takes its name because it was found out in
the western electric Hawthorne plaint in Chicago. In such conditions people may react differently because of anxiousness, the investigator did not inform the subjects that an experiment was being conducted. But the groups were given equal treatment.

(5) *Multiple-Treatment Interferences*

In some experiments, many treatments were tried out on the same subjects. As a result, there may be interactions among the different treatments. The residual effect of a treatment may remain when another treatment is planned. But in this study, the investigator was very careful about avoiding any type of interference during their two months. The students were made interested in E-content in Teaching of Mathematics Education alone.

(6) *Interaction of selection and experimental variable*

There is always a chance of affecting the results of the experiment due to selection and experimental variable for the study. But by taking remedial measures, it has been controlled in the following ways:

- Since the learners are common in achievement, there is less chance of interactive variable.
- The syllabus was also the same.

### 3.13 CONCLUSION

Methodology involved in this study is discussed in detail in this chapter. Each and every step was taken with great care and executed. The threats of internal and external validities were controlled by the necessary steps. All the procedures involved in this research were well explained. The next chapter deals with the Analysis and Interpretation of Data.