

CHAPTER 3

METHODOLOGY

INTRODUCTION

Research is an activity caused by an instinct of inquisitiveness to acquire knowledge. The methodology of research serves as a systematic framework through which the study has to travel. Dhondyal (1994) defines research methodology as “a procedure designed to the extent to which it is planned and evaluated before conducting the inquiry and the extent to which the method for making decisions is evaluated”.

A well-planned methodology offers the investigator a scientifically valid and economically justifiable plan for testing the hypothesis and arriving at conclusions. This research endeavour focuses on assessing how Vedic mathematics-based instruction contributes towards the achievement and attitude of primary and upper primary students in their mathematics education.

3.1 RESEARCH PROCESS

The process of research encompasses a systematic series of steps that are essential for the successful execution of research as given in Figure 3.1.

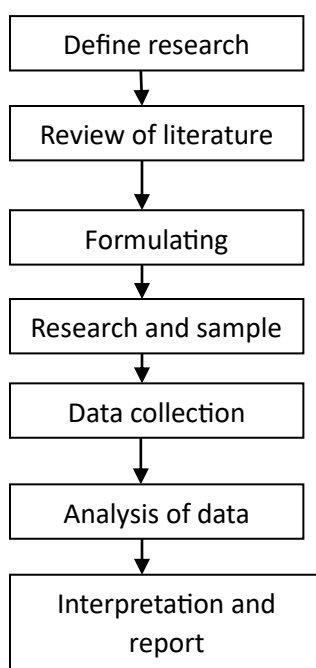


Figure 3.1 Steps in the research process.

3.2 CONCEPTUAL FRAMEWORK:

A conceptual framework provides a visual outline of the variables selected for the research. A conceptual framework is the simplest form of analyzing a problem by depicting the variables and how they are related to one another diagrammatically. Anyone who aspires to understand what has been studied can be guided by the conceptual framework. A conceptual framework includes the process of selecting a topic in a particular area of problem. After selecting a valid topic, research questions can be framed related to the problem and this can be followed by a deep review of the related literature which helps to relate the variables and select the variables for the study.

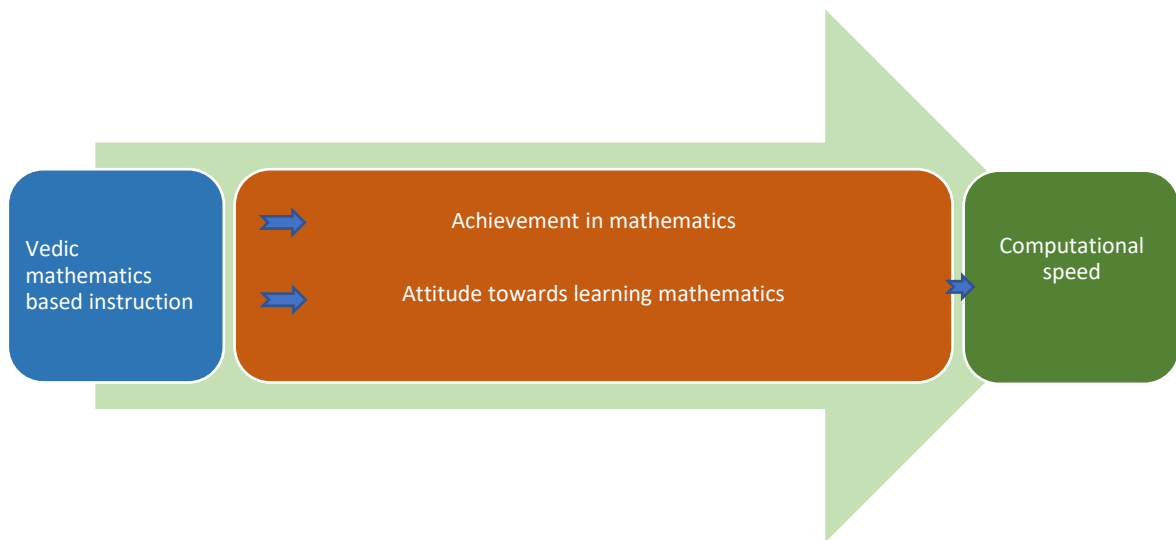


Figure:3.2 Representation of Conceptual Framework

3.3 OUTLINE OF THE STUDY:

The investigator aims to evaluate how Vedic mathematics contributes to the academic performance and attitudes of third and eighth-grade students in learning mathematics focusing on those from government-aided and private schools located in Gudalur, The Nilgiris district. A significant number of students perceive mathematics as a challenging subject, prompting the investigator, who is also an educator, to consider the possibility of teaching mathematics in a more accessible and anxiety-free manner. This contemplation inspired the development of a teaching approach utilizing Vedic methods, to assess their effectiveness on students' mathematical achievement and attitudes. A sample comprising 160 students from both the third and eighth grades was selected for this investigation. The study involved an intervention based on Vedic mathematics instruction,

focusing on measuring students' performance in mathematics and their attitudes towards the subject, which guided the formulation of the research topic. **“Effectiveness of Vedic mathematics-based instruction on achievement in mathematics and attitude towards learning mathematics among primary and upper primary students”**.

3.4 METHODOLOGY ADOPTED IN THE PRESENT STUDY

1. Method used in the present study.
2. Variables
3. Locale of the research
4. The sample
5. The tools
6. Data collection procedure.
7. Scoring and tabulation.
8. Data analysis.

3.4.1 METHOD USED IN THE PRESENT STUDY:

The experimental method is chosen for the present research. An experiment is a process executed to ‘support, refute, or validate’ a hypothesis. The word ‘experiment’ depicts a controlled experiment, but occasionally controlled experiments are very difficult or unfeasible, in those situations ‘natural experiments’ or ‘quasi-experiments’ are used. ‘Natural experiments’ rely on observations of the variables whereas in ‘controlled experiments’ one or few variables are manipulated. Experiments are generally conducted to test the strength of relationships between variables. The primary disadvantage of the non-experimental methods is the inability to manage the situation. Experiments allow for precise control of variables; it can be replicated. In the experimental method, researchers identify specific essential variables, formulate hypotheses, carry out interventions, collect data, and interpret the result based on the analysis of the data.

According to Gay L.R. (1992), “the experimental method is the only method of research that can truly test a hypothesis concerning cause and effect relationship. It represents the most valid approach to the solution of educational problems, both practical and theoretical, and the advancement of education as a science”.

3.4.2 EXPERIMENTAL DESIGN:

“Pretest- Posttest Control group Design” was used in this investigation. Students were assigned randomly to both groups, the experimental and the control group. Samples were randomly assigned to the experimental group which received Vedic mathematics-based instruction or to the control group which experienced the conventional teaching method. Both groups underwent a pretest before the intervention and a post-test following the intervention.

3.4.3 VARIABLES

The word variable is derived from the root word “vary” meaning change can be measured, that is they can be counted or subjected to a scale. It may change from group to group, person to person, or even within one person over time. It is essential to define and identify the variables when designing quantitative research projects. A variable represents a logical grouping of attributes and can assume different values.

The number of variables that can be taken for the study is unlimited and there are different types of variables like ‘independent and dependent variables, active and attribute variables, continuous, discrete, categorical, extraneous, and demographic variables.

3.4.4 INDEPENDENT AND DEPENDENT VARIABLES

In research, a dependent variable is characterized by one that is influenced by other variables, whereas the variable that influences is known as the independent variable. The dependent variable represents the outcome that the investigator aims to measure. Independent variables are those that the investigator can control and can involve modifying an existing variable or adding new variables to the research. The variables used in this investigation are:

Independent variable: The teaching methods namely, Vedic Mathematics-based instruction and the conventional method of teaching mathematics.

Dependent variable: Achievement in mathematics, Attitude towards learning mathematics, computational speed.

Intervening Variable: Learning style.

3.4.5 LOCALE OF THE STUDY

The investigator has selected Gudalur in the Nilgiris district for the present study. Nilgiris is the queen of hill stations. Nilgiris Mountains are blue hills. It forms the part of the Western Ghats in western Tamilnadu of southern India. There are 61 schools in and around Gudalur and it includes 30 government schools, 5 government-aided schools, and 26 private schools. The investigator selected three schools namely ‘Saint Mary’s High School’, ‘Saint Mary’s Primary School’, and ‘Saint Sebastian Matric High School’. ‘St Mary’s High School’ and ‘Saint Mary’s Primary School’ are government-aided schools, here the classes are from grade 1 to grade 10. More than 1015 students are studying in this school. ‘Saint Sebastian Matric High School’ is a private school and was selected to carry out the research for grades three and grade eight, this school consists of about 1400 students of which 780 students are girls and 760 students are boys.

3.4.6 SAMPLE:

A sample is defined as a segment of the population that has been selected to represent the characteristics of the entire population. The population of this research comprises all the VIII and III-graders of the Nilgiris district, but the accessible population is a part of eighth-grade and third-grade students of Gudalur.

According to Best and Khan (2003), “the primary purpose of research is to discover principles that have universal application, but to study a whole population to arrive at generalizations would be impracticable, if not impossible”. The investigator selected three schools in Gudalur namely, Saint Mary’s High School, Saint Mary’s Primary School, and Saint Sebastian Matric High School. The study involved experimental and control group students from private and government-aided schools and among the three schools two were government-aided schools and one was private schools.

3.4.7 Justification for the selection of two different classes as samples:

The investigator intended to determine the effectiveness of Vedic mathematics-based instruction on the achievement in mathematics and attitude towards learning mathematics. It was decided to conduct the study on eighth-grade government-aided and private school students. Schools were selected in Gudalur the Nilgiris district and after getting permission, a pretest was conducted for both the experimental and control group students. Vedic mathematics-based instruction was taught for the experimental group and

mathematics was taught in the conventional method namely ALM for VIII grade for the control group. After the intervention, a post-test was conducted and the data were collected. The collected data was scored and consolidated and on analyzing the data, it was found to be insignificant. Later it was decided to conduct the study for third-grade government-aided and private school students and the study involved a sample of 160 students of third-grade.

Table 3.1

Break Up of the Final Sample Selected for the Study

Grade	Category	Type	No: of students	Percentage	Total
VIII	Gender	Male	86	53.75	160
		Female	74	46.25	
	Type of School	Government Aided	80	50	160
		Private	80	50	
III	Gender	Male	64	40	160
		Female	96	60	
	Type of School	Government Aided	80	50	160
		Private	80	50	

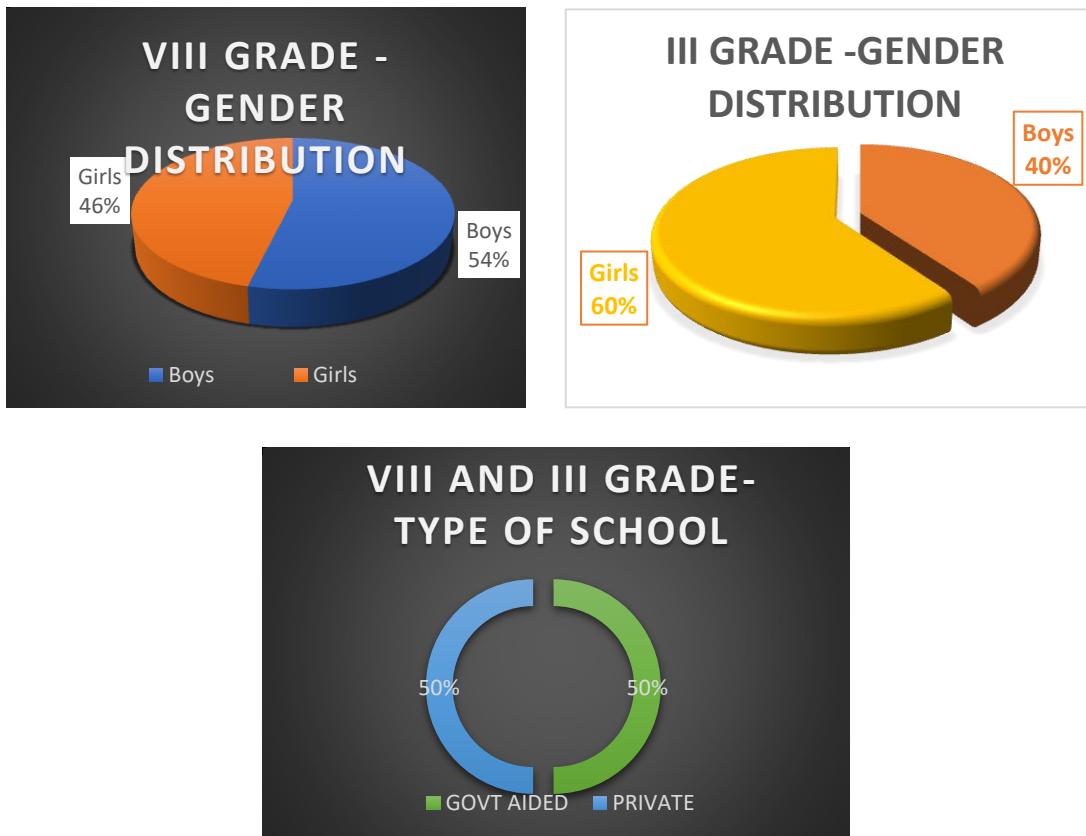


Figure 3.3 The details of Eighth and Third-grade samples

3.5 CRITERIA FOR SELECTION OF CONTENT

The investigator being a postgraduate in mathematics used the concept of Vedic mathematics when preparing for a competitive examination, which made her solve the problems quickly and had an idea to implement this method to the school students, which resulted in the selection of the topic for her research as ‘Effectiveness of Vedic mathematics-based instruction on achievement in mathematics and attitude towards learning mathematics among primary and upper primary students’.

As Vedic mathematics was new to the students of both eighth and third grade, it was necessary to teach them from basics and thereby basic arithmetic operations, and a few concepts such as square root, cube root, squaring and algebraic multiplication were planned to be included in the package. For eighth grade, along with basic arithmetic operations, square root, cube root, squaring and algebraic multiplication were taught in both conventional and Vedic methods. For third grade, as they are at the primary level only basic arithmetic operations namely addition, subtraction, and multiplication were taught in both conventional and Vedic methods for control and experimental groups respectively.

The content was taken from the eighth and third grades of the State Board syllabus of Tamilnadu.

3.6 THE TOOL

The various methods of data collection include the use of relevant recording forms, termed as tools or instruments. Tools assist in obtaining all the data required for attaining the research objectives. The number of tools available to acquire data and their methods of acquiring data employs distinctive ways of describing and quantifying the data. The tools used for the present study are:

3.6.1 Previous knowledge test on mathematics for eighth grade(prepared and validated by S.Yogeshwari and Indu. H,2018) and third grade (prepared and validated by S.Yogeshwari and Indu.H,2019).

3.6.2 Instructional package on Vedic mathematics (Prepared and validated by S.Yogeshwari and Indu.H (2018,2019).

3.6.3 Lesson Transcripts based on Vedic mathematics for third and eighth grade.

3.6.4 Lesson Transcripts based on Active Learning Methodology for eighth grade and Activity-Based Learning Method for third grade.

3.6.5 Achievement test in mathematics for eighth grade (prepared and validated by S.Yogeshwari and Indu. H 2018).

3.6.6 Achievement test in mathematics for third grade (prepared and validated by S.Yogeshwari and Indu. H 2019).

3.6.7 Attitude towards learning Mathematics scale for eighth grade (prepared and validated by S.Yogeshwari and Indu. H 2018).

3.6.8 Attitude towards learning Mathematics scale for third grade (prepared and validated by S.Yogeshwari and Indu. H 2019).

3.6.9 Learning style preference inventory for eighth and third grade students(prepared and validated by S.Yogeshwari and Indu. H 2018,2019).

3.6.1 PREVIOUS KNOWLEDGE TEST FOR EIGHTH GRADE

The investigator developed a tool to assess the knowledge and entry-level behavior of students. This tool was standardized and validated to ensure reliability. Initially, the test comprised 50 questions. Based on the expert's opinion 8 questions were deleted and an item analysis was conducted, and based on the results, 30 questions were selected for the final version of the tool.

Scoring Scheme for the Previous Knowledge Assessment:

The scoring mechanism was structured so that the correct answer was awarded 1 point, and incorrect answers resulted in 0 points. The final score for each student was calculated by adding the points from all 30 questions. Consequently, the highest possible score on the test was 30, and the lowest possible score was 0.

Pilot study:

The draft test was conducted to a random sample of 100 students in grade eight consisting of 50 from government-aided schools and 50 from private schools. The response sheets were collected, and each student's responses were scored individually. An item analysis was then performed, and the most suitable questions were taken for the final form of the test.

Validity

‘Validity pertains to the extent to which a test accurately measures what it is meant to assess’. In the context of educational and psychological assessments, validity is crucial because it guarantees that the test results are ‘meaningful, reliable, and applicable’ to the construct being measured.

Content Validity is a specific validity that analyses whether a test adequately encompasses the entire range of the subject matter it is supposed to assess. It ensures that the test items represent all aspects of the content area and that no significant parts of the construct are overlooked. In this previous knowledge test basic mathematics content validity and face validity were done on experts' opinions.

Item Analysis:

The characteristics of each item on the test can be evaluated through a process known as item analysis, which is conducted to improve the accuracy and effectiveness of the questionnaire or test items. Initially, the total scores for all 100 response sheets were

calculated. Each response sheet's total score was determined, and then the sheets were ranked in descending order based on these total scores. The top 27% (27 response sheets) and the bottom 27% (27 response sheets) of the 100 response sheets were selected for further analysis.

The calculation of the difficulty index was done using the formula $P=N_r/N_t$ with P denoting the item difficulty index. Here N_r refers to the total number of students from both the high and low groups who answered the item correctly. To determine the discriminating power of each test item, twenty-seven percent of students from both the high and low groups were selected, and the formula $D=(G_H-G_L) / N$ was employed. ' G_H is the number of correct answers in the high group, G_L is the number in the low group, and N is the number of students in either group'. Since all items displayed positive discrimination, none were rejected or revised based on discrimination power. However, items with difficulty levels between 0.3 and 0.8 were accepted, resulting in the reduction of the draft scale from 42 items to 30 after the item analysis.

The final tool is given in Appendix IV. Details of the item analysis of the Entry level test are given in Appendix III.

The assessment of the test's reliability was performed by the application of Cronbach Alpha test resulting in a coefficient of 0.813. This score indicates that the tool is reliable.

3.6.2 CONSTRUCTION AND VALIDATION OF THE INSTRUCTIONAL PACKAGE

“An instructional package on Vedic mathematics was constructed on basic arithmetic operations, square root, cube root, and algebraic multiplication based on the state board syllabus of Tamil Nadu for the third and eighth grades”. The package contains 14 modules that explain the sutras involved and the different steps followed in Vedic mathematics.

The steps followed in the construction of the instructional package are:

1. The content was identified.
2. Construction of draft package.
3. Validation of package through criterion test.

Identification of the content:

The content identified should foster the goals and objectives of the instructional package and it should facilitate the students learning. The investigator planned to find the effectiveness of an instructional package on Vedic mathematics among eighth and third-grade students. On this view, the investigator constructed an instructional package on Vedic mathematics for both grades. As Vedic mathematics was new to the students, the investigator needed to select the content at the basic level. Based on the syllabus set forth by Tamil Nadu state board, the content was chosen from third and eighth-grade books.

Arithmetic operations namely ‘addition, subtraction, multiplication, and division’ were taken and a few concepts like square root, cube root, squaring of numbers, and multiplication of algebraic expression were considered to be the basic and necessary content to teach Vedic mathematics. For the third grade, only the basic arithmetic operations were taken for intervention namely addition, subtraction, and multiplication, and for the eighth grade in addition to the basic arithmetic operations, square root, cube root, squaring of numbers, and multiplication of algebraic expression was included in the package.

Construction of draft package:

The package on Vedic mathematics-based instruction was drafted with the aim it helping the students to learn mathematics easily. It included basic arithmetic operations namely ‘addition, subtraction, multiplication, and division’ for III grade. A few more basic concepts were included in the package such as square root, cube root, squaring of numbers, and multiplication of algebraic expressions in the module prepared for VIII grade. Modules were prepared for each topic and lesson plans were written for it. The language followed in preparing the modules was non-ambiguous and clear. The steps followed in each sutra were explained clearly one after the other, to make the learning process an easy task. Vedic mathematics consists of sixteen core sutras and thirteen additional sub-sutras which help in the execution of mathematical operations. In this module, the sutras that have been used in basic arithmetic operations, square root, cube root, squaring of numbers, and multiplication of algebraic expressions only were and hence five Vedic sutras and one sub-sutra were considered. The sutras that have been used to teach basic arithmetic operations, square root, cube root, squaring of numbers, and multiplication of algebraic expressions are given below.

Sankalanam sutra is one of the sixteen sutras of Vedic mathematics. Sankalanam means addition by which addition can be made easily and quickly. For subtraction, Nikhilam Navatash Caramam Dashatah Vedic sutra is used. In addition to this vinculum numbers are also necessary to do subtraction. In the case of multiplication, Urdhva Tiryagbhyam Vedic sutra is used, which means vertically and crosswise, and for division, we use Nikilam and ParavartyaYayojet. which means transpose and apply. To find the square root of perfect squares, the Vedic sub-sutra, Vilokanam was used which means mere observation. Cube roots are also calculated with the help of the Vedic sub-sutra Vilokanam, Addition of algebraic expression uses Vilokanam sutra, and subtraction of algebraic expression uses Nikhilam Navatash Caramam Dashatah. Multiplication of algebraic expression is done by a Vedic sutra Urdhva Triyagbhyam which means vertically and crosswise. Squaring of numbers ending with five can be done by using a Vedic mathematics sutra named Ekadhikena Purvena which means one more than the previous.

VEDIC MATHEMATICS PACKAGE

The package is developed on Vedic mathematics that was rediscovered by Indian mathematician ‘Jagadguru Shri Bharathi Krishna Tirthaji’ in the period between A.D 1911 and 1918. It involves sixteen core sutras and additional sub-sutras. Vedic mathematics is a collection of techniques that enhance critical thinking which make calculation easy and fast. It gives a clear picture of the mathematical concepts hidden and also develops creativity in students. Vedic mathematics improves the decision power and allows the students to excel in any type of calculation.

Using the steps followed in the conventional teaching method, solving problems may be a demanding and time-consuming endeavor. but, by using Vedic mathematics and general and specific techniques numerical computations can be executed with great speed.

Mathematics through Vedic methods can solve calculations more efficiently and swiftly. It eradicates fear of mathematics. It is a fun-filled way that increases interest and positive attitude among students. Vedic mathematics sharpens the mind and increases ‘intelligence’, ‘speed’, and ‘accuracy’. It strengthens memory and fosters self-confidence.

Educational implications

Vedic mathematics creates confidence in students and helps them get rid of Math phobia. It enables an individual to resolve mathematical issues significantly more quickly

while facilitating informed decision-making. School students and competitive exam aspirants will benefit from the amazing Vedic methods that alleviate the challenge of memorizing difficult concepts, enhancing the child’s concentration and fostering a positive attitude toward skill development.

Structure of Vedic Mathematics Package for Basic Mathematical Operations (VMPBMO)

This package contains 14 modules including basic arithmetic skills, squares, square roots, cube roots, and algebraic multiplication for the Eighth grade and 8 modules for the third grade. The modules of eighth grade are divided into 74 lesson plans of which 37 lesson plans on the Vedic method and 37 by ALM method. Whereas for third grade 8 modules were divided into 20 lesson plans on Vedic mathematics and 20 by ABL method. This module is based on the mathematics book of the Tamil Nādu State board syllabus for eighth grade and third grade. This package consists of modules that explain the sutras involved and the various steps that are followed in Vedic mathematics.

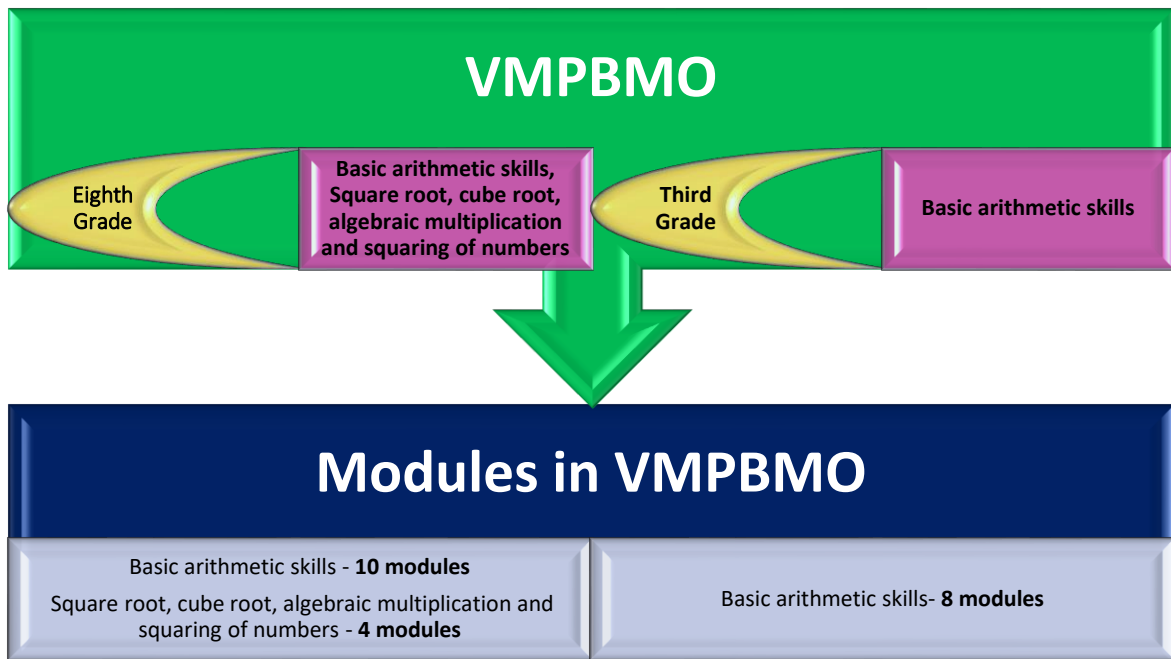


Figure: 3.4 Vedic Mathematics Package for Basic Mathematical Operations

Procedure for the development of the VMPBMO

VMPBMO is framed such that it is easily accessible to the students with elaborate steps and explanations. Students will find more comfortable with the language used and

will easily understand the procedures followed. Each module has a particular framework that consists of the below-mentioned subheadings.

1. Module title
2. Module duration
3. Module overview
4. Learning outcomes
5. Content
6. Pedagogical strategy
7. Activity
8. Feedback
9. Evaluation

Validation of draft package by CVR Test:

An instructional package with high quality will lead to valid and reliable evidence. It is imperative in this endeavor, to have the opinion of the experts because it would help to understand the nuances that are to be added or any modifications to be done in the content of the instructional package.

A panel of Subject matter experts including mathematics teachers and teacher educationists validated the draft version of the instructional package based on Vedic mathematics. A total of eight experts were involved in the content validation process, which was assessed using Content Validity Ratio (CVR) Test.

Content validity is an essential aspect of test development, ensuring that the test items adequately represent the domain of interest. One method of assessing content validity is through the Content Validity Ratio (CVR) test, introduced by Lawshe (1975). The CVR test involves a panel of subject matter experts who evaluate every item for its pertinence to the content measured. Each expert rates whether the test item is "essential," "useful but not essential," or "not necessary." The calculation of CVR for each item is done through the following formula:

$$CVR = (N_e - N/2) / (N/2)$$

- N_e represents the count of experts who rated the item as essential.
- N signifies the total number of experts.

Table:3.2

The content validity ratio for the package.

Module	Ne	CVR
1	7	0.75
2	6	0.50
3	8	1
4	7	0.75
5	8	1
6	8	1
7	8	1
8	8	1
9	8	1
10	8	1
11	7	0.75
12	8	1
13	8	1
14	7	0.75

The critical value for CVR for eight experts must be ≥ 0.75 , the content validity of the present package was found to be 0.89, which indicates that the package is valid.

The Content Validity Ratio value can vary from -1 to +1, where a positive value suggests a stronger agreement among experts about the item's necessity. A higher CVR score means the item is considered valid by the majority of experts. For an item to be retained, its CVR must meet or exceed the critical value based on the number of panellists. Items that do not meet the required threshold are revised or discarded to maintain the content validity of the module.

Table 3.3 Breakup of the content and the sutras used in VMPBMO:

MODULE TITLE	1. Addition of two-digit numbers	2. Addition of three-digit numbers	3. Addition of four-digit number
MODULE DURATION	1 hr.	2 hr.	2 hrs.
MODULE OVERVIEW	Adding non carrying and carrying 2-digit number	Adding non carrying and carrying 3-digit number	Adding non carrying and carrying 4-digit number
LEARNING OUTCOME	To add non carrying and carrying 2-digit number	To add non carrying and carrying 3-digit number	To add non carrying and carrying 4-digit number
PEDAGOGICAL STRATEGY	Sankalanam sutra	Sankalanam sutra	Sankalanam sutra
ACTIVITY	Working on board	Made in groups and were encouraged to do fast calculation	Working on board
FEEDBACK	Addition for non-carrying and carrying 2 digits done correctly	Addition for non-carrying and carrying 3 digits done correctly	They enjoyed doing 4-digit addition in this new method
EVALUATION	Add: $22 + 46$, $32 + 21$	Add: $231 + 356$, $368 + 262$	Add: $2321 + 3657$, $3432 + 4689$

MODULE TITLE	4. Subtraction of 2-digit number	5. Subtraction of 3-digit number	6. Subtraction of 4-digit number
MODULE DURATION	3 hrs	3 hrs	3 hrs
MODULE OVERVIEW	Subtracting non borrowing and borrowing 2-digit numbers	Subtracting non borrowing and borrowing 3-digit numbers	Subtracting non borrowing and borrowing 4-digit numbers
LEARNING OUTCOME	To subtract non borrowing and borrowing 2-digit numbers	Subtract non borrowing and borrowing 3-digit numbers	Subtract non borrowing and borrowing 4-digit numbers
PEDAGOGICAL STRATEGY	Nikhilam Navatash Caramam Dashatah	Nikhilam Navatash Caramam Dashatah	Nikhilam Navatash Caramam Dashatah
ACTIVITY	Students were made in groups and were asked to do subtraction	Students were asked to work out few problems on subtraction	Students actively participated in board test
FEEDBACK	The students did the subtraction confidently	Students were able to do subtraction in very short time	Students enjoyed doing subtraction using Vedic mathematics techniques
EVALUATION	Subtract: 36-25, 43-36	Subtract:236-124, 363-275	Subtract:3826-2614, 5678- 4396

MODULE TITLE	7. Multiplication of 2-digit numbers	8. Multiplication of 3-digit numbers	9. Multiplication of 4-digit numbers
MODULE DURATION	3 hrs.	3 hrs.	3 hrs.
MODULE OVERVIEW	Multiplication of 2-digit numbers	Multiplication of 3-digit numbers	Multiplication of 4-digit numbers
LEARNING OUTCOME	To multiply 2-digit numbers	To multiply 3-digit numbers	To multiply 4-digit numbers
PEDAGOGICAL STRATEGY	Urdhva Tiryagbhyam	Urdhva Tiryagbhyam	Urdhva Tiryagbhyam
ACTIVITY	Students were asked to calculate problems on multiplication	Students were asked to board test on few problems on multiplications	Students were asked to do multiplication quickly in a minimum time
FEEDBACK	Students were able to do multiplication in a single step without complications	Students were happy to do multiplication in Vedic methods as it was easy comparatively	Students had a great fun in learning multiplication in an easy way
EVALUATION	Multiply 32×63 , 42×26	Multiply 236×632 , 463×367	Multiply 6432×2124 , 6389×7321

MODULE TITLE	10. Division of numbers	11. Square root	12. cube root
MODULE DURATION	3 hrs	3 hrs.	2 hrs.
MODULE OVERVIEW	Dividing numbers above and below the base	Finding square root of perfect squares	Finding cube root of numbers
LEARNING OUTCOME	Two divide the numbers above and below the base	To find square root for perfect squares	To find cube root of numbers
PEDAGOGICAL STRATEGY	Nikhilam sutra & Paravarthya sutra	Vilokanam sutra	Vilokanam
ACTIVITY	Problems were given to students in groups and were asked to solve	A game of finding square root was conducted and were encouraged to solve in minimum time	Students were asked to work out few problems on cube root
FEEDBACK	Division was done accurately and fast	Square root was done easily and correctly	Cube root was done accurately and in an easy way
EVALUATION	Divide $6427 \div 8$, $13799 \div 113$	Find square root of 4489 & 784	find cube root of 35937, 68921

MODULE TITLE	13. Algebraic expression	14. Squaring of numbers
MODULE DURATION	3 hrs.	3 hrs.
MODULE OVERVIEW	Multiplying algebraic expression	Squaring of numbers ending in 5
LEARNING OUTCOME	To find the product of algebraic expression	To find the square of numbers
PEDAGOGICAL STRATEGY	Urdha Tiryagbhyam	Ekadhikena Purvena
ACTIVITY	Students were asked to do multiplication for algebraic equations on the board	Students were asked to do mind calculations to find squares
FEEDBACK	Multiplication of algebraic equations was done correctly and quickly	Squaring of numbers was done quickly
EVALUATION	Multiply $(2x+3y)(4x+5y)$	Find the square of 85,75,25

LESSON TRANSCRIPTS:

Based on the Vedic mathematics instructional package, 37 lesson plans for the eighth grade and 20 lesson plans for the third grade were written. For the control group, 37 lesson plans for the eighth grade and 20 for the third grade were written. The lesson plans for the eighth were written in the ALM Method, and the third-grade lesson plans were written in the ABL method.

3.6.3 Lesson transcripts based on conventional for third-grade and eighth- grade.

LESSON PLAN – Grade three (Conventional method)

TOPIC: Addition of two-digit number

DURATION: 1 hour

GENERAL INSTRUCTION OBJECTIVES

TO ENABLE THE PUPILS:

- 1) To understand the basic arithmetic operation
- 2) To develop arithmetic skills of the students
- 3) To apply the basic arithmetic skills in real-life situations.

SPECIFIC INSTRUCTIONAL OBJECTIVES:

Enable students to:

- Understand the place values of the numbers.
- Add the number having two digits.
- Use the skill of adding numbers in suitable situations.

INSTRUCTIONAL MATERIALS:

- i) Charts- To explain the place value of the numbers
- ii) General Aids – Blackboard and Chalk

INTRODUCTION:

- **Motivation:**

Students, you have already learned in your lower classes about place value, in this class we shall learn how to add two-digit numbers

- **Recap:**

The teacher asks the students to add 2 chocolates and 2 cookies to recall the concept of addition

SURVEY:

By giving few examples of addition and asking them to understand the concept with the guidance of the teacher.

- i) What is the place value of 3 in 23?

Ans: Ones

- ii) Nitu has 2 mangoes and Preetha has 1 mango, how many mangoes are there in total.

Ans: 3 mangoes.

UNDERSTANDING:

A) Concept

$$\begin{array}{r} \text{Eg: } 24 \\ + 7 \\ \hline 31 \end{array}$$

$$\begin{array}{r} \text{Eg: } 43 \\ + 9 \\ \hline 52 \end{array}$$

$$\begin{array}{r} \text{Eg: } 24 \\ + 19 \\ \hline 43 \end{array}$$

B) Teacher Solving Problem:

$$\begin{array}{r} \text{Eg: } 36 \\ + 58 \\ \hline 94 \end{array}$$

$$\begin{array}{r} \text{Eg: } 16 \\ + 37 \\ \hline 53 \end{array}$$

$$\begin{array}{r} \text{Eg: } 76 \\ + 68 \\ \hline 144 \end{array}$$

C) Individual Solving Problem:

Add: i) $23+45$, ii) $64+17$, iii) $73+28$

D) Group activity:

The teacher arranges the students into small groups, with each group comprising 5 members and they were asked to add the two-digit numbers $43+68$, and $33+79$ by discussing within the group.

E) Presentation of Small Groups:

Students are asked to present their works.

ACTIVITY:

Find the places where addition is used in real-life situations.

EVALUATION:

Students were given a few problems and were asked to do on the board.

ASSIGNMENT:

Students were asked to add the following numbers

Add: i) $47+86$, ii) $64+72$, iii) $23+68$

LESSON PLAN- Grade eight (conventional method)

TOPIC: Subtraction of 4-digit number

DURATION: 1 hour

LEARNING OBJECTIVES:

Enable students to:

- Understand the concept of subtraction.
- Subtract the numbers having four digits
- Use the skill of subtraction in appropriate situations

INSTRUCTIONAL MATERIALS: Blackboard and chalk

MOTIVATION:

Last class we learned to do subtraction for 3 digits, today we shall learn subtraction of numbers with 4 digits.

LEARNING AND TEACHING ACTIVITIES:

Eg: 3965	Eg: 4325	Eg:6432	Eg: 8431
$\begin{array}{r} 3965 \\ - 2956 \\ \hline 1009 \end{array}$	$\begin{array}{r} 4325 \\ - 2678 \\ \hline 1647 \end{array}$	$\begin{array}{r} 6432 \\ - 561 \\ \hline 0814 \end{array}$	$\begin{array}{r} 8431 \\ - 7859 \\ \hline 0572 \end{array}$

Eg: 9321	Eg: 6345	Eg:2839
$\begin{array}{r} 9321 \\ - 8520 \\ \hline 0801 \end{array}$	$\begin{array}{r} 6345 \\ - 3284 \\ \hline 3061 \end{array}$	$\begin{array}{r} 2839 \\ - 1141 \\ \hline 1698 \end{array}$

GROUPACTIVITY:

The teacher divides the students into small groups and asks them to do the answers for the questions given below

- i) 7892 - 6928
- ii) 6391 - 3078
- iii) 5498 - 3296

INDIVIDUAL SOLVING PROBLEM:

subtract:

- i) 5678-2362
- ii) 9432-5378
- iii) 8632-6436

EVALUATION:

Randomly the students were asked to solve a few questions and were asked to work out on the board.

FOLLOW-UP-WORK:

subtract

- i) 3978-2685
- ii) 4878-1976.

3.6.4 Lesson transcripts based on Vedic mathematics-based instructions for third-grade and eighth-grade**LESSON PLAN- Grade three (Vedic method)**

TOPIC: Addition of two-digit number

DURATION: 1 hour

LEARNING OBJECTIVES:

Enable students to:

- Know the place values of the numbers.
- Add a number having two digits
- Use the skill of adding numbers in a suitable situation.

INSTRUCTIONAL MATERIALS:

- i) Charts- to explain the place value of the numbers.
- ii) General aids – blackboard and chalk.

MOTIVATION:

Students, you have already learned in your lower classes about place value, in this class we shall learn how to add two-digit numbers.

TEACHING AND LEARNING ACTIVITIES:

Sankalanam sutra, a sutra of Vedic mathematics is used in addition to two-digit numbers. This sutra helps in quick calculation and it means observation.

CONCEPTS:

$$\begin{array}{r} \bullet \\ 26 \\ + 36 \\ \hline 62 \end{array}$$

Steps:

1. Add the last column upwards we get $6+6=12$ this can be written as $10+2$. For 10 we have to put a dot above the second digit 6 and now write the answer as 2.

2. Before adding the second column, we have to count the number of dots in the last column. Carry this 1 to the next column and add $1+3=4$. since it is below 10, we can add 4 upward as $4+2=6$ and write 6 as the answer.

$$\begin{array}{r} \bullet \\ \text{e.g.: } 24 \\ + 8 \\ \hline 32 \end{array}$$

$$\begin{array}{r} \bullet \\ \text{e.g.: } 33 \\ + 9 \\ \hline 42 \end{array}$$

$$\begin{array}{r} \bullet \\ \text{e.g.: } 24 \\ + 19 \\ \hline 43 \end{array}$$

$$\begin{array}{r} \bullet \\ \text{e.g.: } 36 \\ + 58 \\ \hline 94 \end{array}$$

$$\begin{array}{r} \bullet \\ \text{e.g.: } 16 \\ + 37 \\ \hline 53 \end{array}$$

$$\begin{array}{r} \bullet \\ \text{e.g.: } 76 \\ + 68 \\ \hline 144 \end{array}$$

GROUPACTIVITY:

The teacher organises the students into small groups. each group consists of 5 members and they were asked to add the two-digit numbers $43+68$, and $33+79$ by discussing within the group.

INDIVIDUAL SOLVING PROBLEM:

ADD: i) $23+45$, ii) $64+17$, iii) $73+28$

EVALUATION: Students were given few problems and were asked to do on the board.

FOLLOW-UP-WORK:

Students were asked to add the following number

ADD: i) $47+86$, ii) $64+72$, iii) $23+68$.

LESSON PLAN- Grade eighth (Vedic mathematics)

TOPIC: Multiplication of two-digit numbers.

DURATION: 1 hour

LEARNING OBJECTIVES:

Enable students to:

- Understand the concept of multiplication
- Multiply the numbers with two digits
- Use the skill of multiplication in appropriate situations.

INSTRUCTIONAL MATERIALS:

Chart – explaining that multiplication is repeated addition.

General aids – Blackboard and chalk

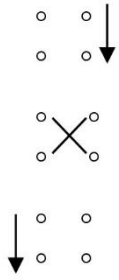
MOTIVATION:

Last class, we learned subtraction, in continuation with that, today we shall learn the arithmetic operation of multiplication of two-digit numbers.

LEARNING AND TEACHING ACTIVITIES:

Multiplication is done using Urdhva sutra which means vertically and crosswise multiplication of two-digit numbers.

Steps:



1) 36×54

Steps

- Multiplication vertically in the ones columns ($6 \times 4 = 24$) write 4 and carry 2
- multiply crosswise and add the two products

$(3 \times 4) + (6 \times 5) = 42$ with this add the carry $42 + 2 = 44$. Now write 4 and again carry 4

- Multiply vertically in the tens columns ($3 \times 5 = 15$) Add 4 which was carried then we get $(15 + 4 = 19)$. Write 19 as such and we get the answer as 1944.

36×54	36×72	76×93
144	72	1228
180	252	684
1944	2592	7068

28×83	92×83	64×93
84	276	192
224	736	576
2324	7636	5952

GROUP ACTIVITY:

The teacher divided the students into small groups and asked them to solve the questions given below

i) 78×92

ii) 83×68

INDIVIDUAL SOLVING PROBLEM:

- i) 63X94
- ii) 96X85
- iii) 46X23

EVALUATION:

The students were randomly called onto the board and were asked to multiply a few two-digit numbers.

3.6.5 Achievement in Mathematics Test for eighth grade:

The investigator developed and validated an Achievement test in Mathematics and the initial draft consisted of 55 items. It was prepared in English and it was translated into Tamil, the regional language also.

The initial draft items were evaluated by three experts in the field of education and two mathematics teachers in school and based on their opinion, a few items were removed and some were revised and leading to a final compilation of 47 items in the tool.

Pilot study

The pilot study serves as an initial framework for the ensuing research. It involved a sample of hundred eighth grade students in Gudalur with an equal distribution of fifty students from Government aided schools and 50 from Private Schools. The instruments were implemented and the responses were gathered, followed by scoring and analysis.

Item analysis and item discrimination

Item analysis is the systematic procedure used to assess the relative difficulty index and discrimination power of the test items. “The main goal of an item analysis is to determine the difficulty and discrimination of each item (Bhatia, 1991)”

Items were analyzed both quantitatively and qualitatively. The qualitative analysis includes the consideration of the content validity. Quantitative analysis is in terms of statistical properties. Item analysis were done to improve the quality of the items in the tools constructed. The difficulty level of each test item was determined by taking 27 percent of participants from both the high performing and low performing group and the difficulty index was subsequently determined using the formula

$P=N_r/N_t$ where P item difficulty index.

N_r = total count of students in the high and low group who gave correct answers to the test item.

N_t = total number of students .

Discriminating power of each test item was determined by taking 27 percent of participants from both the high performing and low performing group, and using the formula.

$$D=G_H-G_L/N$$

Where,

G_H - number of correct answers to the item in the high group

G_L - number of correct answers in the low group

N - number of pupils in either the high or the low group

Since the discriminating power of all the items was found to discriminate positively, no items were rejected or revised based on discriminating power.

The items having a difficulty level below 0.3 and above 0.8 were rejected and the remaining items were taken for the study. Based on item analysis the 47 items in the draft scale were condensed to 35 items.

3.6.6 Achievement in Mathematics for Grade three

The investigator developed and validated an achievement test in Mathematics with 40 items, after discussing with the primary school teachers. The tool was prepared in English as well as in Tamil for better understanding.

Experts opinion

Based on opinions made by two educationists few items were modified and the items of the Achievement test were reduced to 32 items.

Pilot study

A pilot study or item trial should be done to increase the quality of items. 100 samples were taken of which 50 were from Government aided and 50 from Private Schools. The Achievement test was administered and the gathered data underwent scoring and analysis.

Item analysis and item discrimination

Item analysis refers to statistical methods for the selection and rejection of the test items. According to Oosterhof(1990), “item analysis includes two levels of analysis namely the level of item difficulty and the level of item discrimination. Item analysis exhibits the characteristics of a particular item and helps us to maintain the standard of the test”. In the current analysis all the items was found to discriminate positively so no items were revised based on discriminating power. The items with difficulty levels below 0.3 and above 0.8 were rejected and the remaining 20 items were considered for further study.

3.6.7 Attitude scale towards learning Mathematics for eighth grade

Planning of the tool

Planning determines the steps necessary to arrive at the intended destinations. Planning paves the way for effective decisions.

The attitude scale towards learning Mathematics for eighth grade was developed and validated by the investigator after thoroughly analyzing the different views on attitudes towards Mathematics and by referring to various related journals and books, the tool was framed.

Personal opinions were considered from 100 students from Government aided and Private schools towards the subject of Mathematics. The opinions of the students were systematically recorded and framed based on consolidated opinions. The framed scale comprised of 51 questions. Tamil translation of the tool was also done as it is the regional language.

Judgemental evaluation

After the initial draft of the tool, it was planned to be submitted to the review panel of three experts two from the Education department and one from Psychology. Based on their opinion few refinement was made to the tool and the items were truncated from 51 items to 42 items.

Pilot study

The pilot study engaged a sample of 50 students enrolled in private schools and 50 government-aided schools and the gathered data were analysed through item analysis.

Item analysis

Item analysis is the act of analyzing the responses to evaluate the quality of test items. Separate statistical computations were undertaken to identify the mean and standard deviation of the scores associated with each item in both the high-performing (upper) and low-performing (lower) groups. Following this, the 't' value for each item between the two groups was computed. Items that achieved a 't' value of 1.96 or higher were considered statistically significant and were considered for the final version of the test.

After conducting the item analysis, 39 items had a 't' value greater than or equal to 1.96, while the remaining 3 items had a 't' value below this threshold. Consequently, these questions were excluded, resulting in a final tool comprising 39 items.

Reliability

Best and Khan(2003), “A test is reliable to the extent that it measures whatever it is measuring consistently”. Reliability was done by Cronbach Alpha test and was found to be 0.907.

Validity of the test

Validity pertains to the extent to which a measurement instrument assess the construct it is designed to evaluate. The experts indicated that the test prepared demonstrated face validity and content validity.

3.6.8 Attitude scale towards learning Mathematics for third grade

An appropriate instrument was necessary to assess the attitudes of third-grade students regarding their engagement with mathematics. The investigator first collected the opinions of 100 third-grade students of government-aided and private schools and also reviewed a considerable number of related literature, before constructing the attitude scale. The scale consisted of 45 items in English and was also translated to Tamil as it was the regional language.

Judgemental evaluation:

The initial tool with 45 items was analysed by two experts in the field of education and one in psychology and based on their recommendation a few items were deleted and final tool ended up with 36 items.

Validity of the tool:

In the experts' opinion, the attitude scale had face validity and the content validity.

Pilot study:

The feasibility of a tool is enhanced by a pilot study. The investigator conducted the pilot study with 100 students, 50 each from private and government-aided third-grade students. The data obtained through the pilot study was scored and subjected to item analysis.

Item analysis:

The t-test was used for item analysis and items with a t-value below 1.96 are considered not to be effective at distinguishing between the high and low performing groups, leading to their deletion from the test.

After removing these ineffective items, the tool was left with a more refined tool consisting of 20 items. This process ensures that the remaining items contribute more effectively to assessing the test's intended construct.

Reliability:

A tool that consistently measures the same characteristics, regardless of how many times it is administered, is considered reliable. The assessment of test's reliability was done through Cronbach's alpha, resulting in a value of 0.872, suggesting that the items on the test are well-correlated and contribute to a coherent measure of the construct.

3.6.9 An inventory of Learning style preferences for both third and eighth students

The learning style preference inventory was developed and validated by the investigator based on three learning style preferences namely visual, auditory, and kinesthetic. The investigator framed the inventory such that the students may easily understand. Initially, the tool constructed comprised 50 items.

Judgemental evaluation:

The inventory so constructed with 50 items was set forth to a review panel consisting of two psychological experts and two teacher educators. Following the recommendations provided by the experts, the number of items was subsequently reduced to 36.

Validity:

The tool's validity is reliant on its capacity to bring out the solution to the problem of research and experts opinion affirm that the present tool possesses both face validity and content validity.

Pilot study:

The pilot study was done on 200 students of which 100 students are from eighth grade which is further divided as 50 from private and 50 from government-aided schools. In a similar manner, a sample of 100 third grade students were selected comprising 50 individuals from both government and private school sectors. The data collected through the pilot study was further exposed to item analysis.

Item analysis:

The effectiveness of the tool is enhanced through item analysis. By evaluating each item individually, adjustments can be made to ensure that each item accurately measures the intended construct. This process enhances the quality of each individual item, thereby elevating the overall quality of the tool. In this analysis, the top 27% of the upper group and the bottom 27% of the lower group were chosen for evaluation. A t-test was conducted, and items with a t-value greater than 1.96 were retained. As a result, the final tool comprised 20 items.

Reliability:

The reliability of the tool was assessed using Cronbach's alpha, a statistical metric utilised to determine the internal consistency among the test items. The resulting Cronbach's alpha value of 0.954 indicates a strong level of reliability, suggesting that the items exhibit a high level of correlation and effectively measure the same underlying construct. This high reliability suggests that the tool consistently produces similar results under similar conditions, reinforcing its robustness and dependability in assessing the targeted characteristics.

3.7 Planning and Conduct of Study

After constructing the package and finalizing the tools, the study was carried out. Data collection for the study took place from January to March 2019 for the eighth-grade students, and from January to February 2020 for the third-grade students. To administer the tools, the investigator first approached the Chief Educational Officer of Nilgiris

District for permission and then to the heads of the institutions where the intervention was carried out to seek approval for conducting the research. Following this, the investigator met the relevant school teachers to get their support, ensuring cooperation in the study, and also assessed the students' prior knowledge to gauge their entry behavior.

The investigator then engaged with the participating students, building rapport before administering the tools. General instructions were explained thoroughly, and any doubts the students had were addressed.

Intervention in the eighth grade was given for 37 days. Before that three days were taken for pre test and after intervention post-tests was given which took three days. And after two weeks delayed post-test was conducted. For third grade, the study intervention period lasted for 20 days, pre and post-intervention tests were conducted for three days each, and a delayed post-test was conducted after two weeks.

It was seen that there were no long absentees or dropouts in the sample selected by the investigator during the intervention. One or two days very few students were absent and for them, extra classes were taken out of class hours to make them learn along with their peer members.

The investigator systematically administered the Achievement test, Attitude, and Learning style providing guidance whenever questions emerged and asked the students to give the responses. Upon concluding the test, the investigator gathered all the response sheets and recorded the duration taken to complete the achievement test.

Scoring and tabulation

For the achievement test, each question with the right response was given a score of 1 and for the incorrect response, it was 0 for both grades. The attitude scale administered to Grade VIII had 39 questions 23 positive and 16 negative items. The attitude scale administered to Grade III comprised of 20 items. Out of the 20 items, 12 were positive and 8 negative. The responses were scored in a systematic procedure. The scoring system for positive statements ranged from 4 to 0, with values of 4,3,2,1,0 against the responses “strongly agree, agree, neutral, disagree, and strongly disagree.” For negative items, the scores were done in the reverse order of that of positive items. After scoring, the data were organized and tabulated, and consolidated for further analysis, by

assigning a number to each participant in the coding sheet. The scores of the responses were recorded.

In the Learning style inventory used for grade three and grade eight students, there were three options related to auditory, visual, and kinesthetic learning styles. The scores are given as 1,2,3 for auditory, visual, and kinesthetic respectively. The frequency of 1,2 and 3 brings out the Learning style. If the count of 1 is dominant it is indicated as auditory, else if the count is 2 it is denoted as visual, else kinesthetic. The data collected were scored and analyzed.

3.8 Data analysis

The analysis of data was performed through the application of different statistical methods like Descriptive analysis, Correlation analysis, Differential analysis involving - Test of significance(t-test) and ANOVA(Analysis of variance).

Conclusion

After collecting the data the scoring was done and data were put under tabulation using the SPSS software. The subsequent chapter provides a detailed report on analysis of data.