
CHAPTER - 3

METHODOLOGY

The collection of information in a sequential, systematic and scientific pattern can be referred to as a research. Methods find a major place in any type of research work. Any research work will be successful if correct and appropriate methods of research are adopted for the study. Also the data collection must be carried out in a scientifically approved and technical manner. The data collection techniques adopted will also predict the success of a research. It helps the researcher to carry out the work in a scientific and a valid manner.

The study presented here is an initiative to assess the effect of Experiential learning on Science Process Skills, Scientific attitude and Achievement in Science of secondary school tribal students of Kerala.

3.1 Conceptual Framework of the Study

A well planned methodology is that it offers the investigator with a scientifically valid and an economically justifiable, acceptable plan for testing the hypothesis and arriving at conclusions.

A conceptual framework is a pictorial presentation of the relationship between the variables that was chosen for the study. This conceptual framework gives the relationship and the linkage between the variables used in the study. It shows the diagrammatic representation of the procedure by which the study is progressing. The model shows the hypothesized connection between the effectiveness of experiential pedagogy in enhancing the science process skills, scientific attitude and achievement in science, of secondary school tribal students.

- **Background of the study**

The study tries to analyse the educational status of the tribal children studying in Class VIII of Asram Schools in Kerala. The study is selected in a sample that is denoted by the honourable ministry of India as PVTG (Particularly Vulnerable Tribal Group). The PVTG is considered as the most deprived tribal group considering their transition to the modern society. In Kerala, 5 tribes have been selected as the PVTG sections and they are given free education in Government Asram Schools. The teaching methodology selected by the researcher was the experiential method that can help these PVTG children to enjoy

what they learn and continue their education that will in turn help in their academic achievement and individual progress.

- **Framing of research questions**

The study is intended to know about the enhancement of scientific attitude, science process skills which in turn are related to the achievement in Science and individual interest in learning and progress. Hence the general research question framed was “*Will experiential learning methodology help increase the science process skills, scientific attitude and the academic achievement in science of secondary school tribal students studying in Asram schools of Kerala?*”

Specific research questions

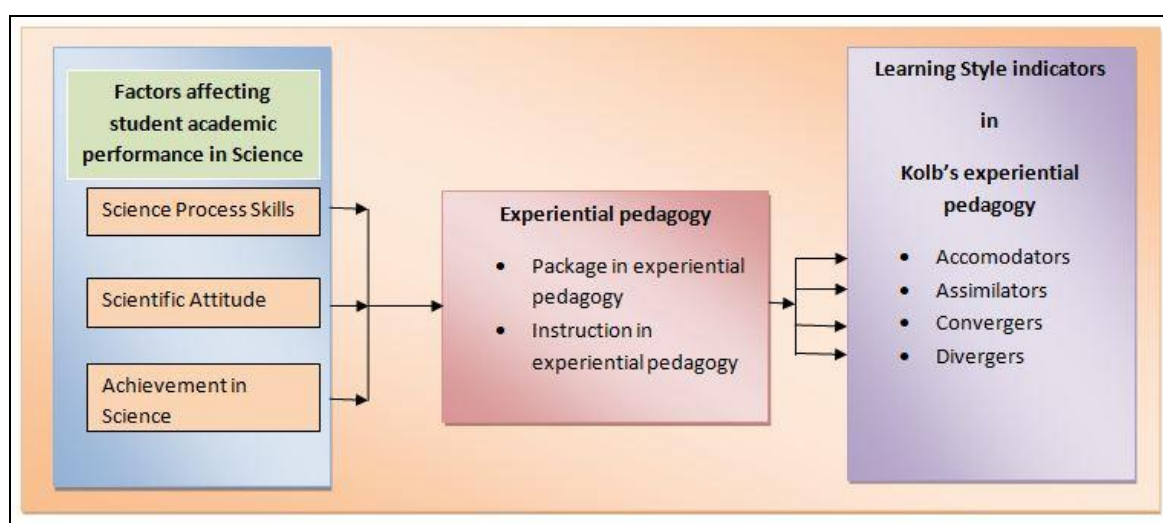
“*Will the different learning styles of the children have an effect on their achievement and attitude?*”

“*Will the achievement and attitude differ after a lapse of two weeks from administering the pedagogy?*”

“*Will there be any relationship between the dependent variables?*”

“*Will there be different levels among the students with respect to the dependent variables?*”

- **Creation of conceptual framework**



The methodology of the present study is discussed under the following headings.

3.2 Design adopted for the study

3.3 Variables for the study

- 3.4 Locale of the study
- 3.5 Selection of the sample
- 3.6 Tools used for the study
- 3.7 Conduct of the study
- 3.8 Data analysis procedure
- 3.9 Conclusion

3.2 Design adopted for the Study

The method adopted was the experimental method as it was considered to be the most appropriate method for attaining the objectives of the study. The classical method of experimentation and problem solving is the basis of the idea behind the experimental method applied in educational researches. This can be regarded as a scientifically and technically sophisticated method in terms of its procedure and application. The experimental method gives a plan for adopting different process in investigating the underlying relationships behind a cause and to derive them under controlled and set conditions. The process helps to identify the conditions behind the occurrence of a given phenomenon. Therefore this type of experimental research gives the explanation or detailed description and the analysis of causes that gives the answer why the cause exists, what is the cause, what will be the result of the cause and likewise many scientific doubts under carefully controlled conditions. The researchers involved in the experimental research manipulate certain specific stimuli, certain treatments or approaches, some specified conditions or some methods in order to observe and analyse the effect that occurs because of the changes made. It must be noted that such changes are purposeful, systematic and deliberately done by the researchers. It should also be taken in to consideration about the intervening factors that may or may not affect the progress of the research in any manner because that may influence the final result of the research. Hence they should be taken care of by the researcher either by controlling them or by removing them and thus help in ensuring a logical relationship between the manipulated variables and the observed variables.

Experimental Design: “single-group pre-test post-test design”

The dependent variable measurement is carried out only for a single time in the sample before the administration of the experimental treatment in a “single-group pre-test post-test design” and the post test is administered after the implementation of the experiment in this particular design. It can be seen that the “single-group pre-test post-test” method is more like or more in congruence with the within-subjects experiment

where in which a participant or an individual is initially tested under some controlled conditions and again the same individual or the participant is tested after a treatment or experimental condition. The incongruence of the “single group pre test post test method” from within the subject arises when the order of testing is reversed. That means a participant or an individual or a group cannot be tested first for the treatment or the experiment condition and then for the controlled conditions. The order must be correct as mentioned earlier and it must be intact.

The significance of the experiment is analysed and concluded when the mean score of the post test is statistically significant than the mean score of the pre test for the group selected as sample. Thus it can be concluded that the applied treatment methodology is significant in enhancing the skills or the identified traits of the sample. This can cater to the progress or the improvement of the sample. This kind of conclusion is one type of method for suggesting the treatment efficacy or the significance of the experiment but it cannot be solely told by just having a higher and significant score in the mean pre test that the experiment is effective. It can depend on some other factors also. At times history may be the reason for higher post test scores. Because of the prevailing situations there can be a higher “post test scores” and a lower “pre test scores”. Such a change in history is quite predictable and natural. In the present study, the sample selected was not affected by the history as they were taught using the traditional method of instruction and that the experiential learning method was a new instruction given to the students for enhancing the academic interest and achievement of the students. Maturation of the sample can be another alternative reason for higher post test scores. The individuals that are involved in the study might have grown over a period of time and that this can affect their cognitive and affective domains which may contribute towards a higher and significant post test scores. This reason is also quite justifiable because as the individuals grow, their teaching learning processes also changes and this makes the means different in their “post test scores”. In the study, the prescribed time for the intervention was limited to three months and the challenge of maturation of the participants involved in, was thus resolved. Hence the challenges to the single group study were resolved accurately in the study.

“Single-Group Pre-test Post-test design: The single-group pre-test post-test design as suggested by Koul (2012) can be illustrated as follows: -

Pre-testing	Treatment	Post-testing
T1	X	T2

Here T1 indicates the pre test that was given to the students before intervention and T2 indicates the post test given to the students after intervention. Also the letter X denotes the treatment given to the single group students during the intervention. Thus the single group checks the effectiveness of the treatment in the same group of students.” (Koul 2012)

This illustration depicts a situation where an existing group is referred to and the result of the treatment or the experiment is directly proportional to the effectiveness of the experiment in the existing group during the implementation of the experimental study in them. A fact must be kept in consideration that the post test administration must never be too long or the time gap between the experiment administration and the post test administration must not be too long as it can lead to erroneous results. So the treatment plan must be in such a fashion that it is in inverse proportion with time. As time increases the effect of the experiment will fade away. Hence it is needed that the post test should be administered without any time delay. Thus it can be concluded that more the time taken to administer the post tests in the sample, the higher will be the occurrence of errors in the results of the experiment.

Need of single-group pre-test post-test design for the study: This study focuses on the academic achievement in the subject science, enhancing science process skills and improving the scientific attitude of the PVTG children studying in two different Asram schools of Kerala. Since the study is involving a minority group and that the study involves a deeper knowledge of the group to be studied, the study demand a precise knowledge of the PVTG group. The sample selected has been reviewed as a sample which needs improvement in their educational standards. Hence they need to get an appropriate standard of design or technique for improving the existing educational training method and implementing a novel method of training that can help develop their interest and attitude towards learning and the prevalent education system. Hence it is possible only if the group is taken as a whole and thus single group design is the best possible design that can be adopted for the study. The two Asram schools in the two districts are selected purposefully since the educational and literacy standards of the tribal population found in these two districts were found to be considerably lower than the other districts of the State as reported in the Socio economic standard report prepared by the Scheduled Tribe Development Department (STDD) Kerala. The literacy standards of the PVTG population

were also found highly depreciating when compared with the other PVTG population in the neighbouring districts. So it was thus planned to conduct the experimental treatment to the Class VIII Asram School students of these two districts, as a whole. The students are first given a pre test to assess their existing standards and then after administering the experimental treatment, a post test is administered to determine the effectiveness of the experiment on the science process skills, scientific attitude, and achievement in science of the Class VIII PVTG students.

3.3 Variables for the Study

Variables have a crucial role in all type of studies. In the present study ‘Effectiveness of experiential pedagogy on science process skills, scientific attitude and achievement in science of secondary school tribal students in Kerala’ the experimental study method is incorporated.

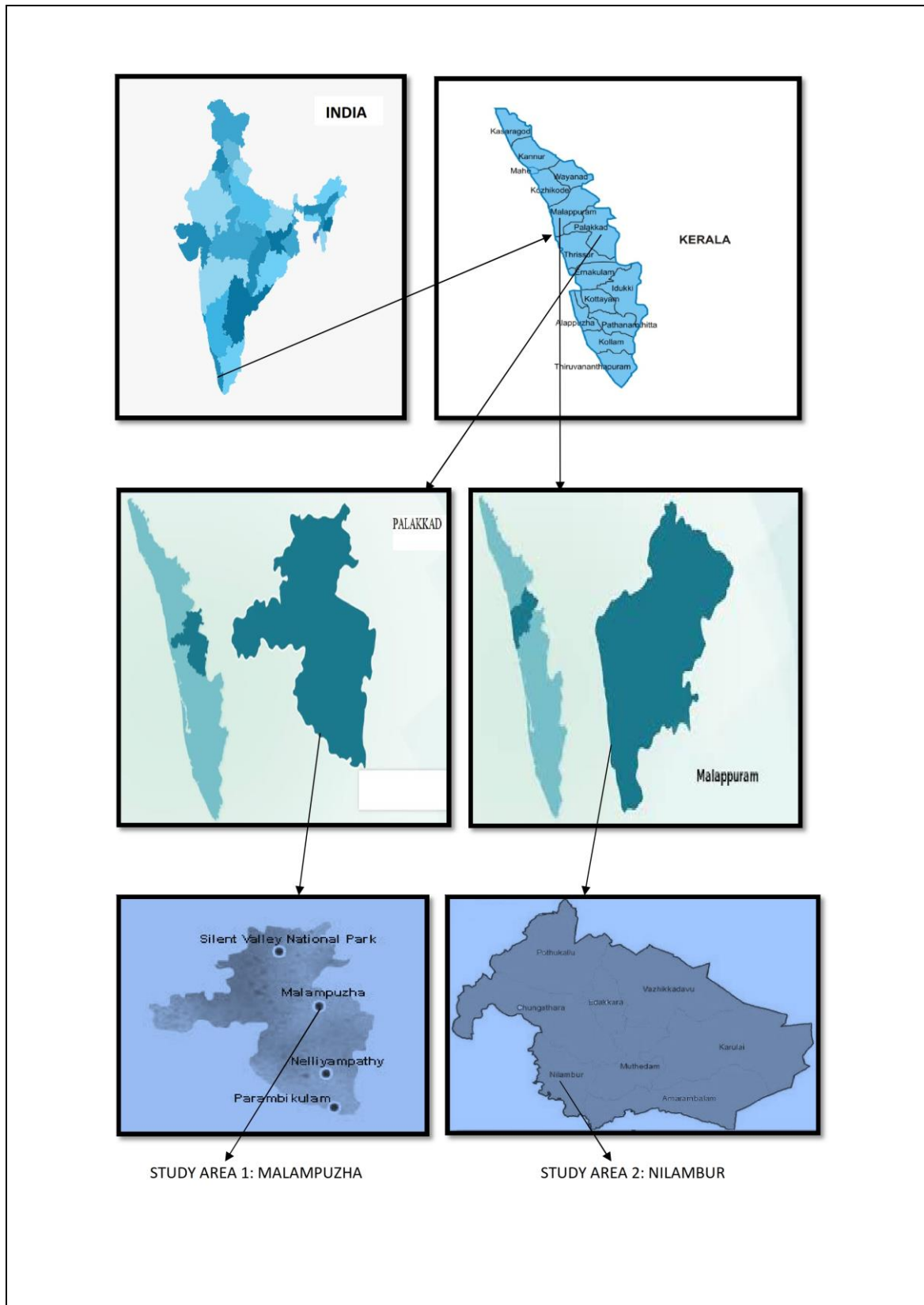
- Testing variable - Science process skills, Scientific attitude, Achievement in Science
- Experimental variable - Experiential Pedagogy
- Design - Single-group pre-test post-test design

3.4 Locale of the Study

The study is conducted in two districts of Kerala. The two districts were selected on the basis of the reviews that reported the literacy levels of the PVTG tribal groups. Kakkoth (2005) reported that the lowest literacy rate among the PVTG tribal group is for “Cholanaickan” belonging to the Nilambur valley which is only 9.17%. Educationally, the PVTG group lag very much far behind the other Scheduled Tribes of the area. Hence the two districts namely Palakkad and Malappuram were purposively chosen for conducting the study. Precisely stating, the locale of the study so chosen were Malampuzha in Palakkad district and Nilambur in Malappuram district. The major PVTG tribal group people included in the study from these areas were Kurumbar from Palakkad, Kadars from Palakkad and Thrissur, Kattunayakans from Palakkad and Kozhikode and Cholanaickans from Nilambur valley. Figure 3.1 shows the detailed view of the locale in the map.

Figure 3.1

Locale of the study



3.5 Selection of the Sample

Population is the whole group on which the study is being conducted. The population for the present study is the high school tribal students studying in Class VIII of Asram Schools in Kerala state. There are 4 Asram Schools in Kerala situated in 3 different districts namely, Palakkad, Malappuram and Wayanad. The total population consists of a total of 160 students belonging to this PVTG which includes “Kadar”, “Kurumbar”, “Kattunayakar” and “Cholanaickar”.

The total sample for the present study consists of 80 students. To obtain sample representatives of the population, the researcher follows purposive sampling technique on tribal ashram schools of Palakkad and Malappuram districts in Kerala.

Criteria for selection of the School: The Asram schools of Palakkad and Malappuram are purposely selected for two main reasons; one reason is that the sample for the study involves a deeper knowledge of the tribal groups involved in the study. Each and every tribal group has their own language and dialect which is exclusive to each tribal community. As a researcher, the study can be progressed smoothly only if the researcher is able to communicate properly and effectively with the PVTG students. Since the students belonging to the PVTG community are freer with their tribal language which has some resemblance with the mother tongue of the researcher these two groups are purposely selected for conducting the study.

The other two tribal schools are situated in Wayanad district of Kerala where the tribal groups have a dialect and speaking language very different from the language that has been followed by the researcher for the administration of the study. Since the language plays a great role in the success of the experiment that is to be administered for the progress of the research, the researcher purposely selected the two schools that are located in Palakkad and Malappuram districts of Kerala for the study.

The second reason for selecting the two Asram Schools in Palakkad and Malappuram is that the two districts when compared to other districts in Kerala have lowest educational standards and more dropouts. The tribal group ‘Cholanaickans’ have the lowest enrolment ratio and literacy rate. They are one among the major PVTG tribal groups that has been selected for the study. On reviewing it has been found that 90 percent of these PVTG tribal group population dropout from their education, either in the secondary level or in the higher secondary level.

Sample Selected for the Study

The researcher used the purposive sampling technique for the selection of sample and conducted the study on 80 tribal students studying in Class VIII of Asram Model Residential Schools of Palakkad and Malappuram districts in Kerala. The break-up of final sample is given in Table 3.1 and it is graphically represented in Figure 3.2

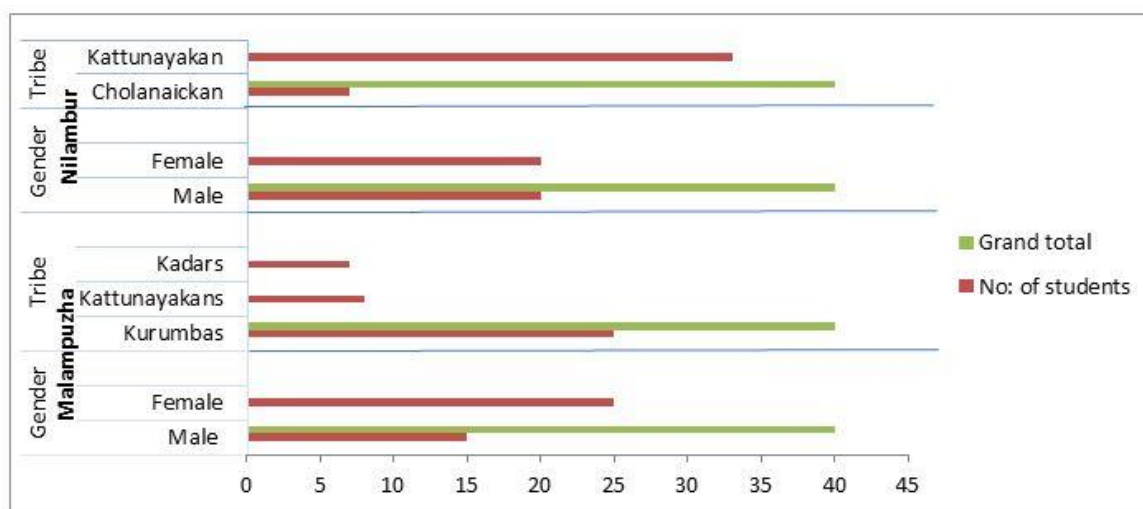
Table 3.1

Break Up of the Final Sample Selected for Administering Experiential Pedagogy

Locality	Category	Type	No: of students	Grand total
Malampuzha	Gender	Male	15	40
		Female	25	
	Tribe	Kurumbars	25	40
		Kattunayakans Kadars	8 7	
Nilambur	Gender	Male	20	40
		Female	20	
	Tribe	Cholanaickan	7	40
		Kattunayakan	33	

Figure 3.2

Sample Distribution



Criteria for selection of the class: For the present study the sample belonging to the population having an age range of 12 and 14 years and studying in Class VIII of Asram Schools of Kerala has been selected. The sample is so chosen because of the occurrence of educational ostracism still prevalent among the tribal groups. It has been reviewed in the studies that 90 percent of the dropout among these students is happening

in the secondary section when compared with other sections. Despite the fact that education has become a fundamental right according to the 86th constitutional amendment (RTE Act, 2002) education is still far reachable for a majority of the tribal population. Due to many social and economic problems the secondary school tribal children are choosing to drop their basic education and leave for daily wage jobs. Refinement of educational practices and teaching methods are essential for improving the progress and achievement of the tribal students for reducing the dropout rates thus making education an enjoyable experience to them. Hence it was decided to select the Class VIII students who belong to the PVTG tribal community and studying in Asram schools as the sample for the study.

Secondly, the process skills are correctly observable and measured during the secondary classes rather than the primary classes. Also it is the apt and appropriate age to build scientific attitude and enthusiasm among the pupils so that they can imbibe the principles and apply them in their future lives. For the study all the basic science process skills and one intermediate process skill has been selected. It was so selected on the basis of the previous testing done during the pilot study.

Criteria for selection of the content: The content planned for the administration of the experiential pedagogical module was sound and static electricity. The content selection was done as per the suggestions received from the subject teachers based on the Physics topics to be covered during the period of intervention. The Physics contents were selected as the researcher herself is a Physics post graduate.

3.6 Tools used for the Study

A tool is a type of device used for the collection of data. The selection of suitable and appropriate instruments or devices for the collection of new and unknown data for the study is highly important for the successful completion of the research work; because the accuracy of research findings is highly depending on the validity and reliability of the tools used. The tools used for the study are as follows:-

- 3.6.1 Previous Knowledge Test in Science (Prepared and validated by Sandhya Kumar, Indu, H, 2018)
- 3.6.2 Experiential Learning Package on Sound and Static electricity (ELPSS) (Constructed and validated by Sandhya Kumar, Indu, H, 2018)
- 3.6.3 Lesson Transcripts on Sound and Static electricity based on Experiential Learning Principles (Adapted framework from, “A story by Padhkar Kumar and Karkar Kumari Experiential Learning”; published by CBSE, New Delhi, 2019)

- 3.6.4 Science Process Skill Test (Prepared and validated by Sandhya Kumar, Indu, H, 2018)
- 3.6.5 Scientific Attitude Scale (Prepared and validated by Sandhya Kumar, Indu, H, 2018)
- 3.6.6 Achievement Test in Science (Prepared and validated by Sandhya Kumar, Indu, H, 2018)
- 3.6.7 Teacher opinionaire on ELPSS (Prepared and validated by Sandhya Kumar, Indu, H, 2018)
- 3.6.8 Student opinionaire on ELPSS (Prepared and validated by Sandhya Kumar, Indu, H, 2018)
- 3.6.9 Reflection on ELPSS by the researcher (Prepared and validated by Sandhya Kumar, Indu, H, 2018)
- 3.6.10 Kolb's Learning Style Inventory KLSI Version 3.1 (Adapted tool prepared by Cheriyan, V.K & Jacob, P.J ,2010).

The construction and the validation of the tools are described as below:

The researcher along with the supervising teacher constructed and validated ten tools in order to find out the student previous knowledge, science process skills, scientific attitude achievement in science, the student and teacher opinionnaire on the experiential learning package and finally the reflection on the package administration by the researcher. In order to test the previous knowledge of the selected students a previous knowledge questionnaire on science was administered on the students to check their knowledge in sound and static electricity. Based on the results obtained, a suitable package on sound and static electricity was constructed according to the principles of experiential learning and it was validated before administering in them to find out the effectiveness of it on the dependent variables.

3.6.1 Development of a previous knowledge test

The previous knowledge test is nothing but a validated test on sound and static electricity, developed on the topic in which instructional package is prepared.

Previous Knowledge Test on Sound and Static Electricity

i. Planning of the previous knowledge test

A tool to test the knowledge and the entry behaviour of the students was prepared by the researcher. It was standardised and validated for reliability. The tool comprises of

50 questions in total and it is divided into 6 sections where in a set of 8 or 9 questions are in each section. The test initially consisted of 60 questions for which the item analysis was done and then out of 60 questions, 50 questions were selected for the final tool. 10 questions were eliminated in the item analysis.

Breakups of the initial number of the items as per the dimensions are given in Table 3.2

Table 3.2

Explanation of the Sections of previous knowledge test

Sl. No:	Sections	Objectives to be tested	Type of questions	Total no: of Questions
1	Section 1	Remembering	Verbal	5
			Non Verbal	5
2	Section 2	Understanding	Verbal	5
			Non Verbal	5
3	Section 3	Applying	Verbal	5
			Non Verbal	5
4	Section 4	Analysing	Verbal	5
			Non Verbal	5
5	Section 5	Evaluating	Non Verbal	5
			Verbal	5
6	Section 6	Creating	Non Verbal	5
			Verbal	5
TOTAL				60

ii. Mode of Responding

There were 60 items in the previous knowledge test. For each there were four alternatives in which one was the correct answer. The respondent was directed to put the symbol of a tick mark (\surd) in the correct alternative among the four options.

iii. Scoring scheme of previous knowledge test

The scoring scheme of the test was given such that the correct answer scored a mark of 1 and the incorrect answer scored a mark of 0.

The summated scores of all the 60 questions provide the total score of the student in the test. Thus the maximum possible score of all the 60 items would be 60 and the minimum possible score would be 0.

iv. Try-out.

The draft was tried out in a random sample of 50 tribal students studying in Class VIII. The response sheets were collected and scored for each individual response separately. Item analysis was done and most appropriate items were selected for the final tool.

v. Item-Analysis.

The item characteristics can be understood from the procedure of item-analysis which is always done to enhance the correctness of the questionnaire or test items. The procedure of the item analysis is discussed below:

First of all, the total score of all the 50 response sheets are found out. Each of the 50 response sheet total is thus calculated. Then the scored response sheets are ordered in the decreasing magnitudes of the total scores and the high 27% (14 response sheets) and the low 27% (14 response sheets) of the total 50 response sheets are separated out. Separate calculations were carried out to find out the mean of the high group and also the standard deviation of the scores obtained so for each individual item in the upper (high) group and the lower group. Then the 't' value for each item in the groups is calculated. Those statements that obtained a 't' value above or equal to 1.96 is considered as a good item and selected for the final draft for measuring the previous knowledge of the tribal students. After item analysis 50 items are having a 't' value greater than 1.96 and the rest 10 questions were having a 't' value below 1.96. So those 10 questions were eliminated. Thus the final tool consisted of 50 items. The final tool in English is given in the Appendix V A. Details of the item analysis of previous knowledge test are given in the Appendix IV.

Finalization of the test

After selection of the items the researcher considered 50 items out of 60 items for the final test. In the final test booklet clear instructions were given. The time required for responding to the test was fixed as 50 minutes. Break-up of the final number of questions with respect to the dimensions are given in the Table 3.3.

Table 3.3*Breakups of the Final Number of Questions in Previous Knowledge Test*

Sl. No:	Sections	Objectives to be Checked	Type of questions	Total no. of Questions
1	Section 1	Remembering	Non verbal	5
			Verbal	4
2	Section 2	Understanding	Non Verbal	5
			Verbal	4
3	Section 3	Applying	Verbal	4
			Non Verbal	4
4	Section 4	Analysing	Verbal	4
			Non Verbal	4
5	Section 5	Evaluating	Non Verbal	4
			Non Verbal	4
6	Section 6	Creating	Non Verbal	4
			Verbal	4
TOTAL				50

There are certain qualities that every measurement device should possess perhaps the two most important technical concepts in the measurement are reliability and validity.

Validity of the test

The most important quality of the testing is its ability to measure what it is intended to measure, the attainment of objectives for which it is designed. According to Best and Kahn (2005) “The validity is that quality of a data gathering instrument or procedure that enables it measure what it is supposed to measure.” A test can never be considered as of no or zero validity or complete or hundred percent valid. The test can stand as a valid one for a particular factor but it may not be the right test or a valid test for any other factor. Hence the validity of a test is a relative one with respect to the research or a problem being tested upon. A point of reference can be fixed and then it can be stated that the test is valid up to that particular point and hence the validity of any test can be verified and established afterwards. In order to ensure that the present test is scientifically valid, the investigator also used the content validity. The item in the tool were selected after judgment of experts and also based upon careful examination of related books. The

method suggested by Lawshe (1975) was employed to find out the content validity. The CVR ratio of the items in the previous knowledge test is given in the Table 3.4

Table 3.4

The CVR ratio of an item in the Previous Knowledge Test

Item	N _e	CVR	Item	N _e	CVR
1	8	1	26	7	0.857
2	8	1	27	8	1
3	7	0.857	28	8	1
4	6	0.714	29	8	1
5	8	1	30	8	1
6	7	0.857	31	8	1
7	8	1	32	8	1
8	8	1	33	8	1
9	8	1	34	8	1
10	8	1	35	6	0.714
11	7	0.857	36	7	0.857
12	6	0.714	37	8	1
13	8	1	38	8	1
14	8	1	39	7	0.857
15	8	1	40	6	0.714
16	8	1	41	8	1
17	7	0.857	42	8	1
18	6	0.714	43	8	1
19	8	1	44	8	1
20	8	1	45	6	0.714
21	8	1	46	7	0.857
22	8	1	47	8	1
23	8	1	48	8	1
24	8	1	49	8	1
25	6	0.714	50	8	1

The content validity is 0.9

Various validities are established for the previous knowledge test. Content validity of the test was also determined as to check whether it is actually measuring the previous knowledge of the tribal students. It was also ensured that the tool possessed face validity as the final items included in the tool were selected according to the suggestions put forward by the subject specialists.

Thus it is believed that the scale constructed by the investigator to know the previous knowledge in sound and static electricity of the selected students is a statistically valid and a proper reliable tool.

Reliability of the test

The reliability of any test can be understood if that test is giving consistent results in continuous or simultaneous testing situations without any change of the variable under study. Similarly a question is considered to be reliable if the students answers that question in same way each and every time it is asked upon to them. Thus the resulting score of that

achievement test will be free from any chance errors occurring in it. There are different ways or methods in order to find out the reliability of a test. The reliability of the present test was calculated using Cronbach's Alpha method and the value of which was found to be 0.736. Previous Knowledge Test final version is attached in Appendix.

3.6.2 Construction and validation of the instructional package in sound and static electricity- ELPSS

The topics selected for the instructional package is Sound and Static Electricity. The instructional package is entitled as "Experiential Learning Package in Sound and Static Electricity" (ELPSS).

Instructional Package

An instructional package can be defined as a self contained, self instructional, self focussed, self paced and independent package consisting of fun learning activities and interesting experiences with a primary focus given to student knowledge construction with the help of a facilitator or support from the instructor. The philosophy behind the instructional package lies behind the fact that each individual can work on his particular unique qualities to achieve an objective in his fullest potential. The procedure adopted by the researcher in developing the instructional package in experiential learning in sound and static electricity involves a number of consecutive steps. These steps are discussed under the following headings.

The sequential series of steps in the construction of an instructional package can be listed down as follows:

- a. Science content of the package was identified
- b. Development of the draft package
- c. Validation of the draft package by content experts
- d. Development of criterion test and validation of the package

Content Analysis

The initial consideration of any type of instructional package must be the organisation of content to be presented. The content can be drawn from a conceptual framework or from an organizational pattern dictated by a highly specialized process. In any case the organization should immediately and clearly communicate with the learner. The title of the activity package should reflect the central theme or the primary idea of the unit of work. Depending upon the amount of the body of the content, the primary data can be broken down into secondary ideas.

In this package, sound and static electricity was chosen by the researcher for the preparation of the instructional package. Based on the theory part of the chapters, different modules were identified. After thorough discussion with experts and the supervisor 15 modules were selected as subdivisions of sound and static electricity.

Table 3.5*Break up of modules*

1	Sound an experience
2	Sound characteristics
3	Vibrations and sound
4	Musical instruments
5	Different sounds
6	The wonder world of sound
7	Travelling with sound
8	Healthy peaceful environment
9	Electrical energy in nature
10	Mater, molecules, atoms
11	Detecting the presence of static charges
12	Avoidance of electric shock
13	Types of charge transfer
14	Conservation of electric charges
15	The natural source of static electricity

The content in Sound and Static electricity for secondary school tribal students was studied by the researcher from many supplementary resources in order to fix the ideas and materials that are required for the correct transaction to the students. The researcher collected the details about the pedagogical analysis of the content, method of processing, information and method of preparation of the instructional package in sound and static electricity.

An important component of the instructional design is the analysis of the concept to be learnt. Content analysis focuses on defining the critical characteristics of the concept and the relationships of these characteristics. This content analysis identifies the external structure of the concept.

Discussion with experts

During the process of developing instructional package on experiential learning package on sound and static electricity, the researcher consulted with a number of experts in the field of experiential learning for taking their expertise opinion. They gave essential suggestions to the development of experiential learning package in sound and static electricity. Some of the experts consulted are listed out in Table 3.6

Table 3.6

Name of the experts and designation

Sl. No	Name of the expert	Designation
1.	Dr. M.A. Sudhir	UGC Emeritus Professor of Education, Gandhigram Rural University, Dindigul
2.	Dr. H. Indu	Professor of Education, Avinashilingam Institute, Coimbatore
3.	Dr. K Sajan	Asst. Professor of Education, NSS Training College, Ottapalam
4.	Dr. Sunil Kumar	Asso. Professor of Education, NSS Training College, Ottapalam
5.	M Subhramanyan	Head master, Asram School, Palakkad
6.	Soudamini	Head mistress, Asram School, Palakkad
7.	K Shylaja	Science Teacher, Asram School, Palakkad
8.	Sanubiya	Science Teacher, Asram School, Palakkad

Elements of the instructional package

The below mentioned are the elements that are included in the instructional package.

1. Introductory elements

Introductory elements consists of the theory used in designing the package, the chapters included in the package, the sample in which the package is to be administered, the time for completing the package and what should be the outcomes of the package.

2. Sub divisions of package

This includes the structure of the package and the procedure for the development of the package. This includes the lessons included in the package and the framework of each module.

Each module has the below mentioned sub divisions.

- | | |
|----------------------|--------------------------|
| a. Module Title | f. Theme and Subtheme |
| b. Module Duration | g. Experiential Strategy |
| c. Module Overview | h. Activity |
| d. Learning Outcomes | i. Feedback |
| e. Content | j. Evaluation |

The most fundamental component for guiding or structuring the behaviour of the learner is a set of objectives. These objectives should be behaviourally stated and should specify the intent, performance conditions and the minimum acceptable level of performance. The domain, the number of objectives and the level of performance are all considerations which are dictated by the content and the manner in which the content is organized.

Activities

The learning activities and the experiences that are prepared in the package are all put in a sequential and a logical manner. These activities and the learning experiences enable the learner to develop behaviour in a determined direction.

The heart and core of this learning package is the experiential learning theory that make the students in constructing knowledge on their own based on the situations and the experiences. These experiences provide each student with a choice of opportunities for efficient use of the wide range of leaning resources and learning experiences. This will help each student to excel in their academic knowledge and also it will make the students understand the process of learning and connect it with situations practically.

Development and Validation of instructional package

The phases of construction of instructional package on sound and static electricity and its validation steps are given below.

Development of instructional package: The development of instructional package can be explained through three phases which are as listed.

- a) Phase1 : Specification period
- b) Phase2: Drafting period
- c) Phase3: Edit tryout period

a. Specification phase

The final result and the effectiveness of a package will be depending upon the first phase of instructional package development which is the specification of topic. Many authors follow different specification steps that are to be followed in the subsequent phases of specification. The listed down steps are regarded as important ones for describing clarity in specification of the instructional package. The specifications are 'Topic, Target population, Entering behaviour, Terminal behavior'

The topic is selected mainly by the knowledge and familiarity of the researcher on the subject, the purpose and rationale behind a logically relevant topic, the need and interest of the investigator in the topic, the use and adaptability of the topic that is to packaged and likewise many other related factors. In the current study the topic sound and static electricity was selected by the researcher which is of particular importance among the selected sample for the study.

While specifying the target population, care must be taken to comprehend about the level of understanding of the learner, the skill of the learners, the interests, cultural background, and intellectual levels of the learners. All these factors of the learner must be specified clearly. In this investigation, the investigator fixes the PVTG students from the VIII standard of Kerala Secondary Schools as the target population for the study.

Knowing the entry behaviour of the students is very much necessary to have an idea about the leaning pattern of the students. This can make a considerable change in making the teaching learning process effective in the chosen sample. So checking the entry behaviour of the sample is essential before a package is introduced to them. To check the entry behaviour of the students, pre testing of the selected topics was administered by the investigator through a basic pre testing on sound and static electricity and then only the instructional package were employed on the sample. The score in the pre testing of the children on the basic science revealed that they require clarity in many topics covered in the chapters sound and static electricity. The score indicated that they require hands on training and practise in 80 percent of the topics mentioned in the chapters sound and static electricity

By stating the terminal behaviour, the instructional objectives can be specified clearly. By following this practice not only the learner but also the teacher s benefitted. It also provides opportunities to the instructor for defining the content aptly and accurately

and also to plan for the instruction. The learner should be aware about the experiential learning practices. This is the main objective behind package development. The investigator anticipates about the terminal behaviour after the intervention. The outline of the instructional package was prepared by keeping into consideration all the above said conditions and specifications, and also by referring a number of necessary and relevant documents and reference materials that throws light on the aforesaid specifications for construction of an instructional package.

b. Drafting Phase

The second step or the drafting phase of the instructional package is administered once when the above said specifications are met and have been completely prepared. Designing the modules is a technical job. For doing that, the researcher should have a thorough understanding of the theory. Excellent knowledge in the subject with sufficient competency over handling the subject, the researcher can easily design the frames in which he intends to prepare. A clear discussion on the respective nature, division of components and about the different module types must be carried out.

For the present study, the researcher went thoroughly through the reviews that were available online and offline on the chosen topic and the packaged content in the related topics. Researcher consulted experts in the field of Experiential learning to make the package and hard copy of the package is drafted out. The draft was prepared with respect to the nature and performance of the student's standards in the previous knowledge test administered to them earlier.

c. Edit-Tryout Phase.

Now, after the preliminary initial draft of all the modules are completed, it also requires a final round of editing and also a clean review of the included contents. During the editing process, the accuracy, correctness, vocabulary, language, style, content correctness and the content clarity are checked and reviewed once again. This is an important stage in the experimental study. In order to uncover any inadequacies or faults, proper editing and reviewing is necessary and is definitely an inevitable step that should be performed before actual testing.

The main objective of editing the modules according to Espich and Williams (1967) are:

- To terminate the inexactness, inaccurateness and any other inadequacies.

- To enhance the logical flow of the modules.
- To enhance the technical efficiency of the package
- To check the correct application of the instructional materials used.

Validity of the instructional package by experts

Content validity of the instructional package was calculated using the method put forward by Lawshe (1975). It is particularly a process for making arrangements in the package if any needed with regard to the opinion of the judges by checking how essential and needy a particular pack or a module is. Lawshe (1975) suggested that the essentiality and the correctness of each of the module in the package must be judged by each of the Subject Matter Experts (SME) included in the judging panel and for that they should respond to the inclusion or avoidance of each of the module present in the package. If more than 50 percent of the panellists suggest that a module is important to be included in the package, then that module has got content validity. If majority of the panellist agree that the inclusion of a module is very much necessary, it shall get a higher level of content validity. The formula for calculating content validity is,

$$\text{“Content validity ratio (CVR) = } \frac{Ne - N/2}{N/2} \text{ ,”}$$

Where CVR = content validity

Ne=number of SME panellists indicating an item as essential

N=Total number of SME panellists

This formula yields values ranging from +1 to -1. Positive values indicate that at least half the SME’s related the pack as essential.” (Lawshe, 1975)

In the present study the researcher gave the instructional package to 8 Subject Matter Experts. Then the investigator gave time for their judgement and afterwards collected their expert responses on the draft package. Taking these SME values the investigator found that CVR of each module using the above equation. According to Lawshe’s formula, for 8 panellists the minimum value of content validity was found to be 0.714. It indicated the instructional package has high validity .The content validity ratio of each module in the instructional package are given in Table 3.7

TABLE 3.7*The content validity ratio of instructional packs*

Module No:	N _e	CVR
1	8	1
2	8	1
3	8	1
4	8	1
5	8	1
6	8	1
7	6	.714
8	7	.857
9	8	1
10	8	1
11	7	.857
12	6	.714
13	8	1
14	7	.857
15	6	.714

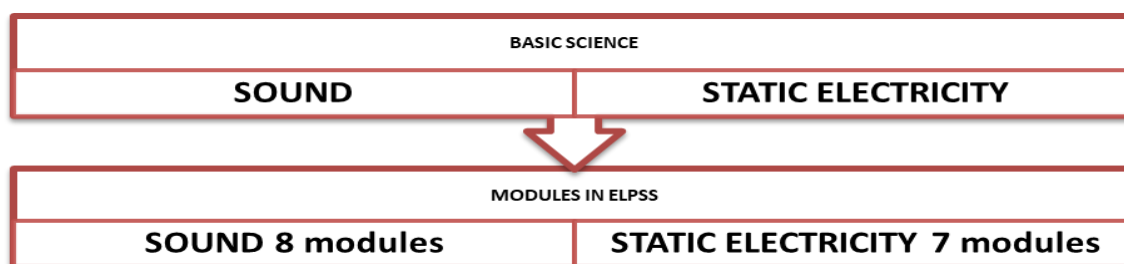
The content validity is 0.9142 which ensures that the instructional package is valid.

Structure of ELPSS

This package ELPSS contains in total 15 modules covering two chapters from secondary school basic science textbook published by SCERT Kerala. The two chapters selected for the package construction and implementation was Sound and Static Electricity from Class VIII Basic Science. This can be effectively used by the students and the teachers by following experiential teaching learning practices. It contains activities and experiments from daily life situations and is easy for the students to comprehend and develop the concept of sound and static electricity.

Figure: 3.3

Structure of ELPSS



Procedure for the development of the ELPSS

ELPS is designed according to a specific framework which has been exclusively designed for the purpose of teaching and learning through experiential learning methods. The modules are designed so that the students get to experiment with the working principles behind a phenomenon. It has enough experiences that help the students to understand the scientific concepts through toys and play way method.

Each module has a particular framework that consists of the below mentioned sub headings.

- | | |
|-----------------------|---|
| 1. Module Title | 7. Pedagogical Strategy (Experiential Strategy) |
| 2. Module Duration | |
| 3. Module Overview | 8. Activity |
| 4. Learning Outcomes | 9. Feedback |
| 5. Content | 10. Evaluation |
| 6. Theme and Subtheme | |

The different phases that are involved in the preparation of all the 15 modules in ELPSS can be tabulated as in Table 3.8

Table 3.8

An overview of the 8 modules in Sound in ELPSS

MODULE TITLE	1.Sound an experience	2.Sound characteristics	3.Vibrations and sound	4.Musical Instruments	5.Different sounds
MODULE DURATION	2 hrs	2 hrs	2 hrs	3 hrs	2 hrs
MODULE OVERVIEW	Classification of sound. Definition of sound.	Properties of sound. Occurrence of different sounds	Higher frequencies produce more sound than lower frequencies.	Nature of the sound produced by different materials Frequency loudness and pitch of sound	Different sounds produce different hearing experiences.
LEARNING OUTCOME	To classify sound sources. To define sound.	To understand simple pendulum To define frequency	To experiment with vibrations of sound. To understand the difference between a vibration and an oscillation.	To understand the characteristics of sound To construct low cost musical instruments	To experience different kinds of sounds
THEME	Sounds that we hear everyday	Natural frequency	Woodworks, drums and percussion instruments	Fun filled musical instruments.	Musical instruments from nature
SUB THEME	Sources of sound	Simple pendulum	Higher frequency vibrations	Balloon horn, Ektara	Tribal musical instruments

EXPERIENTIAL STRATEGY	Narration, Discussion, Identification, Poster making	Observation, Experimentation, Discussion, Group work	Experimentation, Group work,	Model making, Experimentation	Group work, Singing, Dancing, Discussion, Demonstration
ACTIVITY	Classification of sound The experience of sound	Making of simple pendulum. Experimenting with different lengths in a simple pendulum	Dancing light experiment Hacksaw blade experiment	Balloon horn making Ektara making	Singing songs, discussing on their festivals and customs
FEEDBACK	Classification and definition done correctly	Model making was done perfectly. The frequency calculation was understand clearly	Great fun was seen while doing the dancing light experiment. Understood the concept of higher frequency vibrations.	Students identified the main vibrating and the connected vibrating parts of the sound sources.	Students were much familiar with the chosen tribal instruments and actively discussed about the same.
EVALUATION	Name some sound sources Define sound	Define frequency of a simple pendulum What is the unit of frequency	Differentiate an oscillation ad a vibration How do vibrations produce sound	What are the characteristics of sound? Do the sound characteristics vary upon change in frequency of the sound source?	How can one experience different sounds?
MODULE TITLE	6.The wonder world of sound	7.Travelling with sound	8.Healthy peaceful environment		
MODULE DURATION	4 hrs	4 hrs	2 hrs		
MODULE OVERVIEW	The sound depends upon natural frequency of the sound source which in turn depends upon the nature, length, area, tension of the material of the source	Sound needs a medium to travel. Human ear is the organ in human beings that helps us to hear sounds. There are some limits of audibility in human beings.	Noise pollution hampers not only the physical health of living beings but also the mental health of them. There must be measures adopted to eradicate noise pollution for a healthy peaceful environment.		
LEARNING OUTCOME	To find out the factors depending natural frequency	To understand the medium of propagation To find out the limits of audibility in human beings To draw a model of human ear	To understand about noise pollution To understand the measures that must be adopted for the eradication of noise pollution		

THEME	Nature of sound- Loudness and Pitch	Propagation of sound	Noise pollution
SUB THEME	Dependence of natural frequency	Hearing and limits of audibility	Noise pollution and its adverse effects, Measures to reduce it
EXPERIENTIAL STRATEGY	Experimentation, Discussion	Experimentation, Drawing, Model making, Discussion.	Poster making, Role playing, Collage making
ACTIVITY	Rubber band instrument Plastic Pipe drum Straw organ	Toy telephone, Stethoscope model Human ear model Model on limits of audibility	Poster on noise pollution Notice on measures to eradicate noise pollution
FEEDBACK	Students were able to write down the factors that influence the natural frequency of the sound	Students enjoyed the toy telephone activity and were able to understand that a medium is necessary for sound to propagate.	Students made posters that clearly depicted noise pollution. They prepared good notices and measures for eradication of noise pollution.
EVALUATION	What are the different factors that influence the frequency of the sound source?	How do sound travel? Are there any limits of hearing to human beings? Experiment with your own 'Jal tarang'	What are the adverse effects of noise pollution and what all are the measures to eradicate noise pollution?

Table 3.9

An overview of the 7 Modules in Static Electricity in ELPSS

MODULE TITLE	1. Electrical energy in nature	2. Matter, Molecules, Atoms	3. Detecting the presence of static charges	4. Avoidance of electric shock	5. Types of charge transfer
MODULE DURATION	2 hrs	2 hrs	2 hrs	2 hrs	2 hrs
MODULE OVERVIEW	Electrical energy is very important form of energy in everyday life. Current electricity is used here but the electricity that is available from nature is in the form of static electricity which is discussed here.	Matter is made up of molecules and molecules are made by joining atoms. An atom consists of protons, neutrons and electrons.	Electroscope is an instrument to detect the presence of static or stationary charges. The activity to neutralise the charge on a body is known as discharging.	Earthing of a body is done in order to avoid an electric shock by neutralising the charge on the body completely.	The process of conduction is taking place through contact between bodies while the process of induction takes place without any contact between the bodies.

LEARNING OUTCOME	To understand the concept of electrical energy To understand the concept of attraction and repulsion To understand the different type of charges	To understand the structure of atoms To differentiate between proton, neutron and an electron	To understand what is an electroscope To construct a model electroscope To experiment with the electroscope	To understand the concept of earthing To understand how and why earthing is done To symbolize the earth in a circuit	To differentiate conduction and induction in charge transfer To define electrostatic induction
THEME	Charges in nature	Structure of atom	Electroscope	Earthing	Electrostatic induction
SUB THEME	Properties of charges	Characteristics of particles inside an atom	Charging and discharging of an electroscope	How earthing is established in a circuit	Charging by conduction, charging by induction
EXPERIENTIAL STRATEGY	Observation, Group work, Experimentation, Nature walking	Model making, Role playing, Drawing	Experimentation, Discussion	Nature walking, Experimentation, Discussion	Nature observation, Experimentation, Discussion
ACTIVITY	Paper and scale experiment Balloon and flannel experiment	Model of structure of atom Discussion on characteristics of proton, neutron and an electron	Model of a paper electroscope Experimenting with the paper electroscope	Identifying the common colour code of earth, live and neutral wires	Charging by friction Charging by conduction Charging by induction
FEEDBACK	The students were able to understand the properties of electrical charges by their own. Later they were told about the unit of electrical charge and the nature of electrical charge.	The students were engaged in the model making of structure of atom. They were able to understand the properties of each particle inside an atom through the role play	The students actively engaged in making the model of a paper electroscope and experimenting with it.	The students were able to understand the importance of earthing done in all buildings with electricity	The students were able to clearly differentiate between conduction and induction and they were able to arrive at a definition for conduction and electrostatic induction
EVALUATION	What are the properties of electric charges? What type of quantity is an electric charge and what is the unit of electric charge?	What are the particles present inside an atom? What are the characteristics of the particles inside an atom?	What is an electroscope? How is discharging done in an electroscope?	What is the importance of earthing?	What do you mean by electrostatic induction?

MODULE TITLE	6.Conservation of electric charges	7.The natural source of static electricity
MODULE DURATION	2 hrs	3 hrs
MODULE OVERVIEW	With the arrangement of a capacitor, the electric charge can be stored for a very long time. Distribution of electric charge on a conductor will only be on its surface	Lightning is the electric discharge between the charged clouds in the atmosphere or between the charged clouds and the earth. A lightening conductor will help buildings from the potential dangers of lightening.
LEARNING OUTCOME	To define a capacitor To make a model of a capacitor To understand the concept of distribution of electric charge	To understand the concept of lightning To understand the measures to prevent the potential dangers of lightening
THEME	Storage and distribution of electric charges	Thunder and lightening
SUB THEME	Capacitors, Charge distribution	Dangers of lightening and ways to prevent
EXPERIENTIAL STRATEGY	Model making, Discussion	Nature walking, Discussion, Notice preparations
ACTIVITY	Capacitor model Charge distribution model	Areas where lightning rescue conductor is set up Poster to prevent the dangers of lightening and bursting the lightning myths
FEEDBACK	The students were able to understand in which type of surfaces the charge gets accumulated high and less which in turn will help them in preventing themselves from an electric shock.	The students were able to list down many points that will prevent the dangers of lightening
EVALUATION	What is a capacitor? In which type of materials the charge distribution will be high?	What is thunder and lightning? How can one prevent himself from the dangers of thunder and lightning?

3.6.3 Lesson Transcripts on Sound and Static Electricity based on Experiential Learning Principles (Adapted framework from, “A story by Padhkar Kumar and Karkar Kumari” (2019) Experiential Learning; published by CBSE, New Delhi)

The lesson transcripts were prepared according to the framework suggested in the book published by CBSE in the year 2019 on experiential learning. The book tells the framework on the basis of experiential learning as suggested by David A Kolb in his theory (Kolb, 1975). The learning progresses as a learner enter in to the experiential cycle and complete it according to his abilities. According to Kolb, “a learner can enter into the cycle from any of the stages but the learning becomes effective only if the learner completes the four cycle stages of experiential learning.” The lesson plans are devised in accordance with the “four cycle stages like, concrete experience, reflective

observation, abstract conceptualisation and active experimentation.”

The lesson plan is divided into three stages like,

Stage A: Setting the stage for learning,

Stage B: Implementation of the lesson plan: Preliminary phase

Stage C: Lesson Steps: Conclusive Phase

For each lesson plan, after mentioning about the learning outcomes and the required time these steps are followed sequentially till the lesson is completed and assessment is to be carried out. The three steps in the lesson plan can be explained further.

Stage A: Setting the stage for learning

Here the students are firstly checked for their prior knowledge and the researcher tried to understand what the students already know about the topic that is to be taught. After that a pre activity phase is designed where the researcher carried out all those activities that were to be completed before the implementation of the actual activity or content transaction. The resources or the materials that were to be used in the lesson plan to provide correct experience to the students were made ready afterwards.

Stage B: Implementation of lesson plan: Preliminary Phase

Here methods or techniques that can induce curiosity among the student were introduced to them. The lesson plans followed different methods to instil the curiosity element like, role playing and field visiting. These methods were actually different experiential learning strategies which were the pivot points to achieve the lesson objectives. After the activities and experiences, inferences were drawn about the learning experiences and the objectives the learners acquired through the provided learning experiences. This stage was the recording stage of the lesson plan where the learners were made to record their observations after the experiential task.

Stage C: Lesson Steps: Conclusive Phase

Here in this stage the whole activities and the learning experiences were conceptualised by the researcher by gathering the inferences made by the learners in the previous stage. The researcher assimilated the key points and concluded each of them for a better comprehension. Then the researcher extended the lesson further to connect the learning experiences with the real life situations. Lerner participation was also included here to make the learning process meaningful and effective.

Assessment of the lesson plan

The final stage of the lesson plan as prescribed by the model suggested by CBSE was the assessment or the evaluation of the lesson plan to check whether the lesson objectives had been attained or not by the learners. This also included the strategy by which the learners constructed their knowledge in the process of experiential learning. Further any project or an activity based on the topic taught was given by the researcher to assess the performance of the learners.

Format of the lesson plan (devised by CBSE)

The lesson plan is a two column lesson plan including all the three stages mentioned above and also the time required to complete the lesson plan and the learning outcomes. The lesson plan is concluded with an assessment or evaluation section that checks whether the learners have achieved the objectives that were mentioned by the researcher at the preparation phase of the lesson plan.

A model framework of the lesson transcript in sources of sound prepared on the basis of experiential learning principles is given.

Class VIII

TOPIC: SOURCES OF SOUND

“Learning Outcomes”	Students will be able to <ul style="list-style-type: none"> • understand the sound production process • experience the different types of sounds • classify the sound sources
“Time required”	2 hours

A. Setting the stage for learning

“Check for prior knowledge (How do you check what learners already know?)”	Class will be divided into groups of 5-6 students. Learners will be asked to discuss and write: <ol style="list-style-type: none"> 1. Differences between various types of musical instruments used in daily lives. 2. Differences in the nature of sound in a natural sound and a man made sound.
“Pre Activity Phase”	The activity shall be age appropriate. Teacher will have <ul style="list-style-type: none"> • to check the applicability of the activity • visit different places like, a waterfall, a mountain, a river to experience the beauty of natural sounds • inform the Head Master prior to the field visit • ensure to take the reflection of students after the visit
“Resources required”	Paper, Pens, Tuning forks

B. Implementation of the lesson plan- Stage 1 Preliminary phase

<p>“Sparking curiosity (How the lesson will be introduced to create interest and stimulate curiosity of the learners?)”</p>	<ul style="list-style-type: none"> • Students can be asked to observe their own experiences with different types of sounds. They can be asked to make some small paper toys or coconut leaf whistle which they are familiar as a common sound toy • Students can be asked to sing songs they like and share their wonderful experiences on hearing that song for the first time • The above ideas can be followed by a ‘what if’ discussion phase where the students are asked what if there was no sound, what if they and hear and enjoy the beautiful experience of hearing. 						
<p>“Providing the experience (What experiential learning strategies will be used to achieve the lesson objectives?)”</p>	<p>Students can be taken to a nearby place or locality where a waterfall, a river is present and they can enjoy the sounds of birds, sounds of flowing river, sound of wind and thus can appreciate the beauty of this nature.</p> <p>The students are divided into groups of 5-7 for reflecting upon their field trip</p> <p>A detailed finding of the different kinds of sounds that they observed during their field trip can be listed down in a tabular column and give suitable heading after classifying the sounds to a common name.</p> <table border="0" style="width: 100%;"> <tr> <td style="width: 50%;">Man made sounds (Artificial Sounds)</td> <td style="width: 50%;">Natural Sounds</td> </tr> <tr> <td>Vehicle sounds</td> <td>Sounds of birds, animals</td> </tr> <tr> <td>Sounds of musical instruments</td> <td>Sound of natural resources like, wind, water, fire etc.</td> </tr> </table>	Man made sounds (Artificial Sounds)	Natural Sounds	Vehicle sounds	Sounds of birds, animals	Sounds of musical instruments	Sound of natural resources like, wind, water, fire etc.
Man made sounds (Artificial Sounds)	Natural Sounds						
Vehicle sounds	Sounds of birds, animals						
Sounds of musical instruments	Sound of natural resources like, wind, water, fire etc.						
<p>“Drawing inferences (How and in what format learners will record their observations from the experiential tasks assigned to them?)”</p>	<ul style="list-style-type: none"> • The learners can record their observations and compare the observations with the other partners in their group. • The learners are then further motivated to arrive at the factors that are essentially needed for sound production. • All the groups will present their findings for the earning of the whole class 						

• Lesson Steps: Stage 2: Conclusive Phase

<p>“Conceptualization (How will the facilitator assimilate the key aspects of learning from the inferences drawn by the learners?)”</p>	<p>The records and the observations are discussed in the entire class where the facilitator helps them to understand how the sound is produced and what are the essential factors that are need for the sound production ,viz; sound source, medium and a receiver The students are also shown various musical songs showing the natural and man-made sound sources.</p>
<p>“Connecting to real life (How the lesson will be extended further, how it will be linked to real life incidents/situations/processes/systems to make the learning meaningful?)”</p>	<p>The students will reflect upon their observations on sound. How do musical instruments can be made to generate the natural sounds that are so peaceful and calming? How to set up a natural peaceful atmosphere with calming natural sounds to appreciate the beauty of nature and to preserve natural resources</p>
<p>“Extended learning (How will the facilitator provide opportunities to reflect upon the experience in terms of their real life application?)”</p>	<ul style="list-style-type: none"> • Developing a role play of natural sound sources and man-made sound sources • A visit to the nearby radio station to understand the sound production.

“Assessment”

The students can be asked to produce sound from a tuning fork by striking the prongs of the tuning fork on to a rubber head. Bring the tuning fork near to a glass filled with water and the students can make a note of their observations in their notebook and discuss in the class. Pluck cards can be prepared on the factors that are essentially needed for the sound production.

The researcher had prepared 16 lesson transcripts to transact the 15 modules included in ELPSS. There were eight lesson transcripts each for sound and static electricity prepared as per the adapted framework. All the other lesson transcripts are included in Appendix VI in ELPSS Package.

3.6.4 Science Process Skill Test

The researcher administered the process skill test so as to measure the following basic process skills in science subject.

- | | |
|--------------------|-------------------|
| (a) Observation | (d) Measurement |
| (b) Classification | (e) Making Models |
| (c) Comparison | |

The draft tool consisted of 80 questions out of which 60 were selected after the item analysis. The marking scheme was such that every right answer scored 1 and every wrong answer scored a 0.

- **Planning of test**

Proper planning is essential for the construction of most valid and reliable tool. Hence the investigator had gone through authentic books, various written research articles, dissertations, and journals and made an extensive study of the materials regarding various aspects of science process skills for getting theoretical idea regarding the dimensions to be measured by the tools. For preparing the items in the test, discussions with experts and supervising teacher were also conducted.

With regard to the described explanation, the science process skills that were identified by the researcher for preparing the test were Observation, Classification, Comparison, Measurement and Model making. Breakups of the total number of the initial items in the test as per the skills are given in Table 3.10

Table 3.10

Breakups of the Initial Number of Questions as per the different skills of Science Process Skills Test

Sl. No:	Dimensions	Total No: of Items
1	Observation	16
2	Classification	16
3	Comparison	16
4	Measuring	16
5	Making Models	16
	TOTAL	80

- ***Mode of responding.***

There were 80 questions in the process skill test question paper. For each item there are four options given under the respective questions. The respondent was asked to put a tick mark (✓) in one appropriate alternative among the four, against each question.

- ***Scoring scheme of process skill test in science***

The scoring scheme of the test was such that the correct answer scored a mark of 1 and the incorrect answer scored a mark of 0.

The summated scores of all the 80 questions provide the total competence of the student in Science Process skills. Thus the maximum possible score of all the 80 items would be 80 and the minimum possible score would be 0.

- ***Draft Try-out.***

A random sample of 50 tribal students studying in Class VIII of Asram Schools was selected for the administration of the draft test of science process skills. Item analysis was done and most appropriate items were selected for the final tool.

- ***Item-Analysis.***

Appropriate items are selected for the final inclusion of questions in the test by performing the item analysis and determining the item characteristics of each item included in the draft tool. The procedure of the item analysis is discussed below:

The 50 response sheets obtained were scored and the total score of each sheet was found out. Then the response sheets that were scored were arranged in the decreasing magnitudes of their total score and the high 27% (14 response sheets) and the low 27% (14 response sheets) of the total 50 were separated from the group. Separate calculation for the “mean” and “standard deviation” of the scores so far obtained for each individual item in the upper group and the lower group were calculated afterwards. The ‘*t*’ value of each item were calculated. Those items which secured a value equal to or greater than 1.96 were considered as a statistically good item for measuring the science process skills of the tribal students. After item analysis 60 items are having a ‘*t*’ value greater than 1.96 and the rest 20 questions were having a ‘*t*’ value below 1.96. So those 20 questions were eliminated. Thus the final tool consisted of 60 items. The final tool in English is given in the Appendix V B. Details of the item analysis of Science Process skills test are given in the Appendix IV.

- ***Reliability of the Science Process Skills Test***

Cronbach alpha method was used to calculate the reliability value of the Science Process Skill Test and the value of the reliability coefficient was obtained as 0.896.

- ***Validity of the test of Science Process Skills.***

Various validities are established for the test of science process skills.

Content validity of the test determines whether it correctly measures the Science

Process Skills of the tribal students. The tool was also checked for face validity and was made sure that the items included in the test received good suggestions from the subject specialists. The subject specialists included four experts from the field of teacher education and for teachers from schools. Hence it can be justified that the tool to test the Science Process Skills of the tribal students is a valid tool.

Breakups of the total number of the items as per the dimensions are given in Table 3.11

Table 3.11

Breakups of the Final Number of Questions as per the Dimensions of Science Process Skills

Sl.No:	Dimensions	Item Numbers	Total number of questions
1	Observation	1,2,3,4,4,6,7,8,9,10,11,12	12
2	Comparison	13,14,15,16,17,18,19,20,21,22,23,24	12
3	Classification	25,26,27,28,29,30,31,32,33,34,35,36	12
4	Measuring	37,38,39,40,41,42,43,44,45,46,47,48	12
5	Making Models	49,50,51,52,53,54,55,56,57,58,59,60	12
	TOTAL		60

3.6.5 Scientific Attitude Scale

The attitude scale is developed in such a way that it can be used to find out the student's attitude towards science. The scientific attitude scale developed is a 5 point Likert type scale providing 5 options varying from "Strongly Disagree" to "Strongly Disagree".

- **Planning of the scale**

The attitude scale consists of 60 statements of which 31 statements are positive and 29 statements are negative questions.

- **Mode of responding.**

There are 60 items in the scale. For each item there are five alternatives namely "Strongly Agree (SA)", "Agree (A)", "Undecided (UD)", "Disagree (DA)", "Strongly Disagree (SD)". The respondent was asked to put a tick mark (✓) in one appropriate alternative among the five, against each statement.

- ***Scoring scheme of scale of scientific attitude.***

The scoring scheme of the scale was for a positive statement, the marks ranged between 5 and 1 (5,4,3,2,1) respectively for Strongly Agree, Agree, Undecided, Disagree and Strongly Disagree and for a negative statement, the marks are reversed.

Thus the summated total of all the 60 statements provide the overall scientific attitude of the tribal students. Thus the maximum possible score of all the 60 statements would be 300 and the minimum possible score would be 60.

- ***Try-out.***

The draft try out was administered in 50 tribal students studying in Class VIII of Asram Schools. After their completion, the response sheets were collected and scored separately. Each individual score was calculated and tabulated. Item analysis was done in order to select the most appropriate statements for inclusion in the final copy of the tool.

- ***Item-Analysis.***

Item analysis was done same as how it was done for Science Process Skill. All the 60 items were having a '*t*' value greater than 1.96. So, all the questions were considered for the final tool. Thus the final scale also consisted of 60 items with 31 positive items and 29 negative items. The final scale in English is given in the Appendix VC. Details of the item analysis of Scientific Attitude scale is given in the Appendix IV.

- ***Reliability of the scale of scientific attitude.***

The reliability of the scientific attitude scale was determined using Cronbach alpha method and the value of the reliability coefficient was obtained as 0.976.

- ***Validity of the scale of scientific attitude.***

Various validities are established for the scale of scientific attitude of tribal students. Content Validity determines the content of the scale and checks whether it actually measures the scientific attitude of the tribal students. The tool also possesses face validity, as the items were selected after the judgment of subject specialists. The tool was given to four experts from the field of teacher education and four teachers from schools. Thus it is believed that the scale constructed by the investigator to measure the scientific attitude of the tribal students is an effective one for assessing the same and thus it can help the teachers for teaching and for educational purpose is a valid tool.

3.6.6 Achievement Test in Science

The achievement test is constructed by strictly following the guidelines mentioned in the revised Bloom's taxonomy (2001) that assess the educational objectives and hence the academic achievement of the students.

• Planning of the achievement test in science

The achievement test in science as a draft tool consisted of 70 questions from the selected topic. The item analysis was done and then 20 questions were eliminated because of lower significant value of 't'. The blueprint and the weightage to different levels of difficulty as well as objectives of the achievement test in science is given in the Appendix V D.

Breakups of the total number of the items as per the contents after item analysis is given in Table 3.12

Table 3.12

Breakups of the Initial Number of Questions as per the Contents of Science Achievement Test

Sl. No:	Contents	Total Marks
1	Natural frequency	5
2	Sound characteristics	14
3	Sound propagation	5
4	Hearing, Echo	7
5	Human Ear, Audibility	4
6	Limits of audibility	7
7	Static electricity	2
8	Electric charge	11
9	Electroscope	3
10	Earthing	6
11	Capacitors	5
12.	Thunder, lightening	2
	TOTAL MARKS	70

• Mode of responding.

There are 70 questions in the achievement test question paper. For each item there are four options given under the respective questions. The respondent was asked to put a tick mark (✓) in one appropriate alternative among the four, against each question.

• **Scoring scheme of science achievement test**

The scoring scheme of the test was given as follows:

Correct Item	Incorrect Item
1	0

The summated scores of all the 70 questions provide the total achievement of the student in Science. Thus the maximum possible score of all the 70 items would be 70 and the minimum possible score would be 0.

• **Try-out.**

A random sample of 50 tribal students who were studying in Kerala Asram Schools of Class VIII was chosen for this try-out and the draft test was administered on them. The response sheets were collected from them afterwards and scoring of each response sheet was done separately. Item analysis was done and the most appropriate items were chosen for the inclusion of test items in the final tool.

• **Item-Analysis.**

The rationale behind item analysis is to avoid those items that do not satisfy certain item characteristics and to select those items that possess these item characteristics. The procedure of the item analysis is discussed below:

The 50 response sheets obtained were scored and the total score of each sheet was found out. Then the response sheets which were scored were arranged in the descending order of their total scores. Now the 50% top group - 50% bottom group right response method was used to calculate the discriminating power and the difficulty index of the 70 questions. The top group and the bottom group are separated by dividing in to upper half and lower half accordingly. The correct responses for each of the item in the test in each of the upper or top group and the lower or bottom group are then counted. This is done in order to calculate the difficulty index of each item which is one of the item characteristics. In order to obtain the difficulty index, just divide the number of right responses of each item in each group by the total number of students in that particular group. The quotient so obtained is referred to as the difficulty index (D.I) of an item included in the test. For all the items included in the test, D.I is calculated likewise.

$$\text{Difficulty Index (D.I)} = (R_T + R_B) / 2$$

Where, R_T = Right responses in Top Group and R_B = Right responses in Bottom Group

Here the items with D.I=.90 is the easiest and .60 is the toughest. (Ebel & Frisbie, 1986) The next item characteristic is the discriminating power which can be found out by subtracting the number of right responses in each of the two groups. This difference is referred to as the discriminating power of each item included in the test. This is called as the discriminating power (D.P) or the validity index (V.I).

$$\text{Discriminating Power (D.P) or Validity Index (V.I)} = R_T - R_B$$

If the value of the V.I is found to be negative on calculating, it indicates that the bottom group has got more individuals in number who are giving right responses for an item included in the test than the top group. The number of responses that are right in the top group will be less than that of the number of responses that are right in the bottom group. So that item included in the test is not selected as it has got no discriminating power to discriminate between the top and the bottom groups. Thus the final draft of the test will be prepared by omitting that particular item from the draft test. In the same way, if the value of V.I is found to be zero or +1 also, it is not selected for the final draft. Only those items having a V.I of more than +2 are chosen for the inclusion of the questions in final test. 50 items are having a good D.I and D.P value after the conducted item analysis and the rest 20 questions were not having a good D.I and D.P value. So those 20 questions were eliminated. Thus the final tool consisted of 50 items. The final tool in English is given in Appendix IV D. Details of the item analysis of Science Achievement Test are given in Appendix III. After item analysis, 20 questions are deleted from the draft tool, since its validity index or the discriminating power is not satisfactory which means that question cannot discriminate between the high achievers and the low achievers. So those questions are to be excluded in the final draft. So, this tool consisted of 50 items and can be considered as the final tool. The final version of the tool of the science achievement test is given in the Appendix V D.

- ***Reliability value found out for the Science Achievement Test***

The science achievement test was found to have a reliability value of 0.936. The reliability was found out using Cronbach alpha method.

- ***Validity of the test of Science Achievement test.***

Various validities are established for the test of science achievement. Content Validity is that it checks systematically whether an item actually measures what is

intended to measure by it. Only the valid item actually measures the science achievement of the tribal students included in the test in this study. The items were selected after the judgment of subject specialists. Hence it has content validity.

The measurement outcome or the result or the procedure towards the result is being taken into consideration by face validity. As the tool was given to some experts for judgment which was positive, the tool ensured face validity. Thus it is believed that the test constructed by the investigator to measure the achievement in science is a scientifically valid and a statistically reliable one.

The final tool consisted of 50 questions whose blue print is made and administered on the students. The achievement test consisted of one word type questions. The right answers will score a mark of 1 and the wrong answer a mark of 0. Breakups of the total number of the final items as per the contents are given in Table 3.13

Table 3.13

Breakups of the Final Number of Questions as per the Contents of Science Achievement Test

Sl. No:	Contents	Item Numbers	Total Marks
1	Natural frequency	1,16,18,26,32	5
2	Sound characteristics	4,10,17,20,31,42	6
3	Sound propagation	9,13,22,47	4
4	Hearing, Echo	2,3,5,35,43,44,46,49	8
5	Ear, Audibility	11,39,50	3
6	Limits of audibility	12,19,21,28,38	5
7	Static electricity	7, 36	2
8	Electric charge	6,14,24,25,27,29,33,34,41,48	10
9	Electroscope	40,45	2
10	Earthing	37	1
11	Capacitors	23,30	2
12.	Thunder and lightning	8,15	2
TOTAL			50

- **Scoring Key**

The scoring key of the hence prepared draft and final achievement test given to the students is included in the Appendix V D.

3.6.7 Teacher Opinionnaire on ELPSS

After the intervention, the researcher decided to get the feedback on ELPSS package from the teachers. The technique of data collection was planned to be focus group methodology. The investigator prepared eleven open ended questions for teachers. The questions given to the teachers were in written format, and they were given sufficient space in the question paper itself to write down their opinions. They were also given sufficient time to write and record their opinions. Time was given for them so that they are able to think and answer the given questions in detail and could also write notes before they answer. Each question was asked by the researcher, and three to five minutes were given to each teacher for expressing their view points about the same which was further again followed by a discussion of around twenty minutes by all the teachers in the focus group. No interventions or moderations were done by the researcher and that the mere duty of the researcher was to simply ask questions and collect their opinions. The teachers were included in the interview discussion where they were welcomed for their suggestions and opinions on the ELPSS package. Malayalam was used as a language of communication to conduct the focus group discussions as all the teachers included in the interview session were comfortable with that language. The audio-recordings of all the focus group discussions were taken. These record tapes were then transcribed and translated into English language and further it was checked by the researcher. The analysis of the same was done after that. The focus group discussions were not video-recorded so as to respect the privacy of the respondents. After the audio-transcripts were analyzed, all audio recordings were deleted and no personal information was recorded. The responses from the teachers are analysed qualitatively and presented in the results and discussions chapter. The questionnaire is given in Appendix V E

3.6.8 Student Opinionnaire on ELPSS

The student opinionnaire was also done in the same method as that of teachers. The technique of data collection was planned to be focus group methodology. The researcher prepared sixteen open ended questions for the students. The questions given to the students were also in written format, and they were given sufficient space in the

question paper itself to write down their opinions. Time was given for them so that they are able to think and answer the given questions in detail and could also write notes before they answer. Each question was asked by the researcher, and three to five minutes were given to each student for expressing their view points about the same which was further again followed by a discussion of around twenty minutes by all the students in the focus group. No interventions or moderations were done by the investigator and that the mere duty of the researcher was to simply ask questions and collect their opinions. Malayalam the regional language was used as a language of communication to conduct the focus group discussions as all the participants included in the study were comfortable with that language. The audio-recordings of all the focus group discussions were taken. These record tapes were then transcribed and translated into English language and further it was checked by the researcher. The analysis of the same was done after that. The focus group discussions were not video-recorded so as to respect the privacy of the respondents. After the audio-transcripts were analyzed, all audio recordings were deleted and no personal information was recorded. The responses from the students are analysed qualitatively and presented in the results and discussions. The questionnaire is given in Appendix V F.

3.6.9 Reflection of the Researcher On ELPSS

The researcher prepared a reflective journal on the basis of the study conducted during the research programme. The reflective journal included a brief reflection about the conduct of the study, the different activities included in the study and the participation of the students involved in the study. It included twelve open ended questions based on the researcher's reflection on study.

This included reflection about the most interesting activities for the students, the least interested ones, those that took time to complete, those that were completed on time, reflection about the different process skills developed among the students because of the experiential learning practices included in the research, the different difficulties faced by the researcher during the implementation of the study, the different contents that were successfully transacted during the study and those contents that were difficult to transact during the study. The reflection of ELPSS by the researcher is given in Appendix IV G.

3.6.10 “Kolb’s Learning Style Inventory – KLSI Version 3.1 (Kolb, 2005)”

The inventory is included in the study for analysing the learning style of the learners. The researcher is using the “Kolb’s learning style inventory – KLSI-Version 3.1 (Kolb, 2005)” which is adapted according to the age and intellect of the learners. The tool was KLSI Version 3.1(adapted) prepared by Cheriyan, & Jacob(2010).

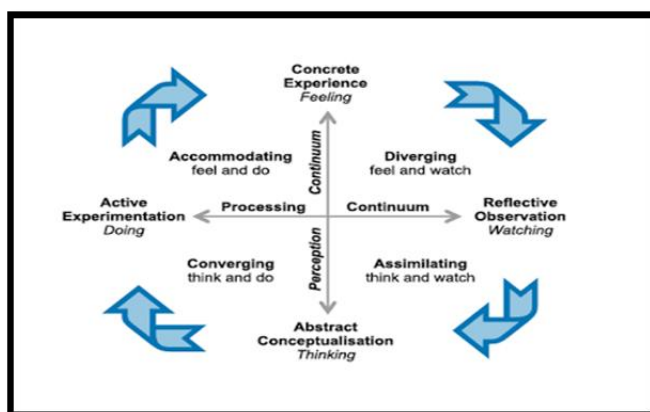
The adapted Kolb’s Learning Style Inventory consisted of 12 questions with four answers and the respondent was asked to tick an appropriate response of his choice. The KLSI Version 3.1 (adapted) (Malayalam & English) is given in Appendix. (Cheriyan, V.K & Jacob, P.J ,2010)

The Kolb Learning Style Inventory (KLSI) helps an individual to develop his best learning standards. KLSI is clearly not similar to any other different tests related to learning style and personality that are applied often in educational researches which are based on the comprehensive foundation of experiential education. David A. Kolb (1971, 1984) has published seven versions of the Learning Style Inventory and the researcher adapted the fifth version of the Learning Style Inventory (version 3.1 which was published in 2005) after minor modifications suited to Indian conditions.

Figure 3.4 describes the four different learning styles of Kolb’s experiential learning and it shows how these four learning styles are divided into four quadrants. It shows the continuum between the four cycle stages as well. The perception continuum and the processing continuum divide the cycle stages and it clearly demarcates the linkage between the different experiences involved in these stages.

Figure 3.4

Kolb’s Experiential Learning Cycle and Learning Styles, (Kolb, 2005)



- **The Assimilating style:** ‘Reflective Observation phase and Conceptualization phases (Kolb, 2005)’ when combined give rise to this style.
- **The Accommodating style:** ‘Active Experimentation phase and Concrete Experience phases (Kolb, 2005)’ on combining gives rise to this style.
- **The Converging style:** ‘Abstract Conceptualization phase and Active Experimentation phase (Kolb, 2005)’ when combined give rise to this style.
- **The Diverging style:** ‘Concrete Experience phase and Reflective Observation phase (Kolb, 2005)’ on combining gives rise to this style.

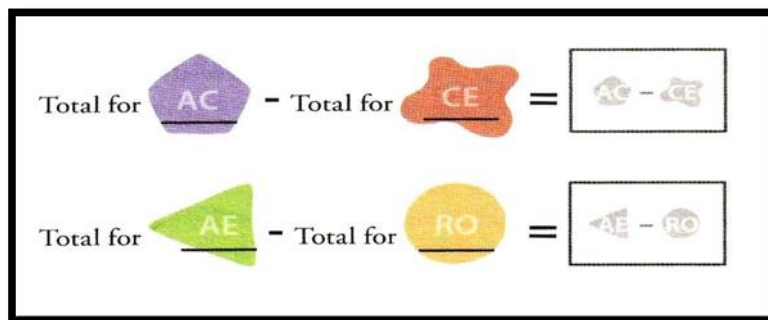
Scoring of the inventory

The adapted version of KLSI included in it 12 questions which are the methods and ways by which one learns his best. There are four answers to each of the question. The statements are to be ranked by the students according to their choice of interest on a scale of 1 – 4 (4 being best). This gives the most preferred and the least preferred method of learning according to their choice. The responses of the students are then later categorised into directly opposite two bipolar concepts: “Concrete Experience (CE) vs. Reflective Observation (RO) and Abstract Conceptualization (AC) vs. Active Experimentation (AE) (Kolb, 2005)”. The rankings made by the students on the statements in KLSI are then analysed and equated to give corresponding scores for “CE”, “AC”, “RO”, and “AE” on the scale. Then “(AE– RO)” and “(AC – CE)” correspondingly can be determined and the final results can be used for marking respectively in the horizontal x-axis or abscissa and vertical y-axis or ordinate, on a grid that determines a student’s preferred set of learning styles. The Kolb Learning Style Inventory (adapted version) in English and its Malayalam translation is given in Appendix V H

In order to determine the learning style of a student, the score for the different learning phases has to be taken, “AC, CE, AE and RO” as listed on the separate additional sheet of the questionnaire and then subtract to obtain a new set of two combination scores that can be recorded in a grid.

Figure 3.5

Scoring the Inventory (Kolb, KLSI Version 3.1 scoring)



Source: KLSI Version 3.1 Scoring (Kolb, 2005)

“AC- CE”: This score will tell how one **takes in** experience.

“AE- RO”: This score will tell how one **deal with** experience.

Now the score obtained for AC – CE can be marked on the y-axis (ordinate) of the Learning Style – and the score obtained for AE – RO can be marked on the x-axis (abscissa) of the Learning Style grid. After this find out where the two combination scores meet on the grid by placing a dot on the intersection point. The dot or the intersecting point will fall in one of the four quadrants the grid. This way the learning style of the students can be properly analysed. The Learning Style was translated to the regional language (Malayalam) also. (Appendix V H)

E.g. If “AC – CE” score value is -3 and “AE – RO” score value is +16, the style is “Accommodating quadrant according to KLSI scoring”.

In the same way learning style quadrants can be identified. “The four learning style quadrants are Diverging, Assimilating, Converging, and Accommodating.”

3.7 Conduct of the Study

After the preparation of the package and finalisation of the tools, the study was administered. The study was conducted during the month of September and October. For administering the tools, the researcher first met the head of the institution, tribal officer of the corresponding district and also the head of research department STDD (Scheduled Tribe Development Department) Trivandrum, and sought permission for the conduct of research. The investigator met the concerned school teacher for help and cooperation in the study and testing the previous knowledge of the students to test their entry behaviour. Then the investigator met the concerned students, created a rapport and the tool were

administered to them, explained the general instructions and all their doubts were cleared. The instructional package was also constructed and validated during this time. It was with the help of the concerned subject teachers, the appropriate content and the different experiential learning strategies were planned. The package was the given for validation to the experts and the CVR ratio was calculated. Accordingly the modules of the package were validated and the package was finally drafted. The researcher was fortunate to receive the sincere cooperation from all the teachers and staffs of the respective Asram Schools of Malampuzha (Palakkad district) and Nilambur (Malappuram district). The details of the sample and the number of students drawn are given in the Table 3.14.

Table 3.14

Details of the Schools and the Number of Students Drawn for Data Collection

Sl.No:	Name of the School	Locality	District	<i>N</i>
1	Gov. Asram School	Malampuzha	Palakkad	40
2	Smt. Indira Gandhi Memorial Model Residential School (IGMMRS)	Nilambur	Malappuram	40

The intervention was personally done by the researcher in Asram Model Residential Schools located at Palakkad and Malappuram districts in Kerala. The intervention was planned to conduct in two stages. As the intervention required a minimum of 60 days to get complete, it was planned that one school can be taken in the first year and another school in the next year. The STDD, Kerala was giving permission for conducting the study for researchers for a minimum period of 60 days and a maximum period of 90 days. So, the conduct of study cannot be completed in two different schools in the same year. Hence the researcher divided the intervention procedure into two stages.

In the first stage of intervention, Asram Model Residential School situated in Malampuzha locality in Palakkad district was selected to conduct the study. As the researcher hails from Palakkad district, it was purposefully chosen for the first stage of intervention. In the second stage of intervention, Indira Gandhi Memorial Model Residential School (IGMMRS) situated in Nilambur locality in Malappuram district was chosen for the intervention.

The researcher was given permission for data collection during the months of September and October in the years 2018 and 2019 respectively. The previous knowledge testing was done during the first week of the September month which was then followed by the administration of the experiential learning package for a time period of three weeks and finally the second week of October was used for administration of the post test in both the schools. After administering the post test the researcher went back to the schools for the conducting a delayed post test which was administered on the second week of November for checking the memory retention in the students.

3.8 Data Analysis Procedure

The following statistical techniques are to be used for analyzing the data quantitatively. To test the data,

1. measures of central tendency,
2. percentage analysis,
3. correlation analysis- Pearson's product moment correlation
4. test of significance and
5. ANOVA is to be used

The teacher opinionnaire and the student opinionnaire was analysed based on percentage analysis. Percentage of varied opinions for the open ended questions included in the opinionnaire was calculated manually and recorded.

3.9 Conclusion

The researcher used the above mentioned methodology to study the 'Effectiveness of Experiential Pedagogy in Science Process Skills, Scientific Attitude and Achievement in Science of Secondary School Tribal Students in Kerala'. The methodology includes the Conceptual Framework of the Study, Design adopted for the study, Variables included in the study, Locale of the study, Selection of the sample, Tools used for this study, Pilot study and Item analysis, Conduct of the study, Data analysis procedure and Conclusion of the study.