Chapter IV  
Methodology

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METHODOLOGY

Introduction

The quality and the success of research studies depend on the appropriate methodology adopted for the investigation. The pre-planned and well designed methodology provides the researcher a scientific and feasible framework for conducting the study. It takes care of the variables and process. The method adopted, the data gathering instruments, the selection of sample, the procedure of the data collection and the statistical techniques employed in the analysis of data are described under appropriate heads as presented in this chapter.

Method of study

The study was conducted by using a non-randomized control-group pre-test, post-test design and carried out in three phases of PREPARATION EXECUTION, AND EVALUATION.

Preparation

Advance Organizer Model learning packing in Biology for secondary level has been prepared under seven stages as follows.

Stage 1: - Identification of a topic in biology from IX standard syllabus of Karnataka

The topic “The Living World” in biology from IX standard syllabus of Karnataka was identified for developing Advance Organizer Model learning package.

Stage 2: - Content analysis of the topic selected

As a preliminary step the investigator analyzed the topic into eleven sub-units, which comprised of classification of living organisms, characteristics of multi-cellular organisms, invertebrates and phylum’s
of the invertebrates. Content analysis of each sub-unit was done in terms of facts, concepts, definitions, generalization, characteristics, habitat, origin, life processes and economic importance. (Appendix-A)

Stage 3: Formulation of advance organizers

Advance organizers were formulated following the steps of developing advance organizers

Identifying Goals: The general goals or objectives of the content to be taught were identified based on the domains of learning i.e.:
- Cognitive
- Affective
- Psychomotor

Hierarchical Structuring of content: The content was organized based on the principles of progressive differentiation' and integrative reconciliation i.e.: the most general ideas of the content (Topic) are presented first followed by gradual increase in detail and specificity. The sequence of the content is organized in such a way that new ideas would be consciously related to previously learned content.

**Formulation** of advance organizers: Based on the type of information to be presented and the previously learned content introductory material in the form of advance organizers were formulated. The type of advance organizers formulated were

*Comparative organizers*

**Example:** Unit: The living World

Sub unit: Characteristics of Multi-cellular organisms

a) Objectives
   - Recognize unicellular and multi cellular organisms
   - Define a tissue, organ and organ system
   - Differentiate between tissue, Organ and Organ system
   - Identify the importance of tissue, organ and organ systems in a human body.
   - Appreciate the concept of multicelliular organisms
### Structuring of Content

<table>
<thead>
<tr>
<th>PROGRESSIVE DIFFERENTIATION</th>
<th>INTEGRATIVE RECONCILIATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>CELLS</td>
<td>Different cells and their types</td>
</tr>
<tr>
<td>TISSUE</td>
<td>Similar kind of cells give rise to a tissue</td>
</tr>
<tr>
<td>ORGAN</td>
<td>Different tissue come together to form an organ</td>
</tr>
<tr>
<td>ORGANSYSTEM</td>
<td>Different organs form an organ system</td>
</tr>
</tbody>
</table>

**Structuring of content**

- The bodies of animals which are made up of many cells are called multi cellular animals/organisms.
- These cells are specialized to perform specific functions,
- A group of cells having common origin and structure, performing similar functions is called a tissue.
- Systematic arrangement of tissue in definite layers gives rise to organ and group of organs to organ system.

**Formulation of Advance organizers**

"A Systematic arrangement of bricks (Cells) give rise to a wall (Tissue) A systematic arrangement of walls (Tissues) give rise to a mom (Organ) A systematic arrangement of moms (Organs) give rise to a house (Organ System) A systematic arrangement (Vertical) of houses(Organ Systems) give rise to an apartment (Multicellular Organisms)"
Stage 4: Preparation of Learning Package based on Advance Organizer Model syntax

Advance Organizer Model Learning Package in Biology on the Topic “The living World” was prepared in accordance with the syntax of the model.

Table 4.1
Syntax of Advance Organizer Model

<table>
<thead>
<tr>
<th>Phase one: Presentation of Advance Organizer</th>
<th>Phase Two: Presentation of Learning task or material</th>
<th>Phase Tree: Strengthening Cognitive organization</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clarify aim of the lesson</td>
<td>Make the organization of the new material explicit</td>
<td>&gt; Relate new information to Advance Organizer</td>
</tr>
<tr>
<td>Present organizer:</td>
<td>Make logical order of learning material explicit.</td>
<td>&gt; Promote active reception learning</td>
</tr>
<tr>
<td>1. Identify defining attributes</td>
<td>Present material and engage students in meaningful learning activities.</td>
<td></td>
</tr>
<tr>
<td>2. Give illustrations.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Provide context.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Repeat and reinforce</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Prompt awareness relevant to knowledge and experience</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Social system
In this model the teacher retains control of the intellectual structure, as it is continually necessary to relate the learning material to the organizers and to help students differentiate new material from previously learned material.

Principles of Reaction
The teachers solicited or unsolicited responses to the learners reaction will be guided by the purpose of classifying the meaning of the new learning material, differentiating it from and reconciling it with existing knowledge making it personally relevant to the students and helping to promote a critical approach to knowledge.
Support System

Well-organized material is the critical support requirements of this model. The effectiveness of the advance organizer depends on an integral and appropriate relationship between the conceptual organizer and the content.

Stage 5: **Evaluation** of Advance Organizer Model learning package by experts

The Advance Organizer Model learning package was evaluated by a team of experts from the field of Education, Psychology and Biological Science. The learning package was evaluated in terms of learning theory, the concept of model of teaching and the content coverage. The main concepts of evaluation are as follows,

1] **Meaningful Verbal learning**
   - Reception learning
   - Organization of cognitive structures.
   - Organization of knowledge (Curriculum)
   - Principle of Subsumption.

2] Advance Organizer Model of Teaching
   - Advance organizers- Preparation and presentation.
   - Syntax of the model.
   - The teacher’s role
   - Specific teaching techniques

3] Biology Content
   - Facts, Concepts and Generalizations selected.
   - Sequencing of the content
   - Reference and examples quoted.
   - Depth of content selected for IX standard students.
   - Analysis of content.
   - Pictures and diagrams used.

Based on the feedback received from the experts, the learning package was modified and finalized for pilot study.
Stage: 8 Pilot study in a try out sample and modification of the package

The try-out was made on a small sample of IX standard students as pilot study before using it for actual investigations. A team consisting of student teachers, teacher educator’s and peer group observed the procedure followed by the teachers while transacting the content in accordance with advance organizer model syntax i.e.: 

*Phase one:* Presentation of organizer, *Phase Two:* Presentation of the Learning task or material and *Phase Three:* Strengthening cognitive organization. Based on the feedback the learning package was modified.

Stage 7: Finalization of the Advance Organizer Model learning package for experimental exposure

The Advance Organizer Model learning package was modified in terms of content, language, presentation, teaching materials & evaluation done by expert team. The learning package was thus finalized for experimental exposure.

**Execution**

The study, as indicated earlier, aims to develop instructional materials for learning Biology. Experimental Method was adopted for the study to determine the effectiveness of the instructional materials developed (on the topic “The Living World”) at the secondary school level.

**Experimental Design**

After consultation with experts in the field, it was decided that a non-randomized control group pre-test, post-test design is the most appropriate method for testing the effectiveness of the instructional material developed' in Biology for Secondary School Level.

In a school situation, it is sometimes practically not possible to disturb class schedules, to gather subjects for obtaining sufficiently
large samples or to re-organize classes in order to employ randomization procedures for getting equivalent control and experimental groups. Under these circumstances, therefore, an experimenter may use pre-assembled groups, such as, intact classes, for framing experimental and control groups. The pre-assembled groups are selected and are administered pre-test. The pre-test scores are analyzed to show that the means and standard deviations of the two groups do not differ significantly. If the pre-test scores for the groups are not equivalent, the experimenter may proceed with the conduct of the experiment by using the technique of analysis of co-variance to compensate for this lack of equivalency between the groups. Once the two groups are obtained, it is advisable to use a random procedure to determine which group is to be assigned to experimental treatment and which one to the controlled condition. After determining the groups the experimental treatment is administered to the experimental group and the post-test is given to both the groups. The difference between the post-test scores between the groups is compared with the help of appropriate statistical test to ascertain the effect of the independent variable.

**Variables**

‘Variables’ are the conditions or characteristics that the experimenter manipulates, controls or observes (Singh 1997). According to Cohen and Manion (1994) an experiment involves making a change in the value of one variable called the ‘Independent Variable’ and observing the effect of that change on another variable called the ‘Dependent Variable’. As Sax (1970) explains, in experimentation, the manipulated variable is called an ‘Independent Variable’ and it is under the direct control of the experimenter. The Variable that is affected by the change in the independent variable is called a ‘Dependent Variable’ or the Variable to which students will be
asked to respond is called a dependent variable. Its effects depend upon the presence or absence or amount of independent variable.

In this study, the instructional materials developed on the topic “The Living World” are the Independent Variable. Whereas ‘Achievement Test’ on the topic “The Living World” is the dependent variable. The Dependent and Independent Variables involved in the study are schematically presented here for better clarity.

Figure 4.1
Schematic Representations of Variables

- **Variable of the Study.**
  - **Independent Variable.**
    1. Instructional materials based on advance organizer model.
    2. Conventional Method of Teaching.
  - **Dependent Variable.**
    Achievement Test on the topic “The Living World”.

**Tools and Techniques used**

The following tools and techniques were used for collecting data for the study,

1) Achievement test prepared by the researcher in Biology
   Pre-test (basic knowledge in biology) (Appendix B)

2) Advance Organizer Model learning package in Biology for the topic “The Living World” (Chapter V)

3) Achievements test on the topic “The Living world” for post test. (Appendix C)
The details regarding the tools and techniques employed for the study are presented as

1) Achievement test prepared by the researcher in Biology
   Pre-test (basic knowledge in biology) (Appendix B)

2) Advance Organizer Model learning package in Biology for the topic “The Living world”.
   Since the main objective of the study is the preparation of Advance Organizer Model learning package, the details of prepared learning package is given in Chapter V

Achievement Test on the Topic “The Living World”

An achievement test on 'the topic ' “The Living world” was constructed by the investigator in consultation with the experts. In the preparation of the achievement test due weightage was given to the instructional objectives and content areas. The test items are based on the category of objectives. Knowledge, Understanding, Application and Skill. The prepared achievement test was evaluated by experts in the field of education. The final test consists of 33 questions and among them, 10 are objective type, 5 analogy type 5 matching type items, 12 short answers and 1 essay type question. The test carries a total of 50 marks and the duration is 1 34 hours. The copy of the final achievement test is given as Appendix C
The details regarding the weightage given to objectives test items, content, details of blue print and the way of scoring are given below.

The weightage given to different categories of objectives in the Achievement in Test are given below.

Table 4.2
Weightage to Instructional Objectives in the Achievement Test

<table>
<thead>
<tr>
<th>Objective</th>
<th>No. of Items</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Knowledge</td>
<td>12</td>
<td>36.3</td>
</tr>
<tr>
<td>Understanding</td>
<td>13</td>
<td>39.3</td>
</tr>
<tr>
<td>Application</td>
<td>06'</td>
<td>18.1</td>
</tr>
<tr>
<td>Skill</td>
<td>02</td>
<td>6.07</td>
</tr>
<tr>
<td>Total</td>
<td>33'</td>
<td>100%</td>
</tr>
</tbody>
</table>

Table 4.3
Weightage to test items in the Achievement Test

<table>
<thead>
<tr>
<th>Item</th>
<th>No. of Items</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Multiple choice</td>
<td>10</td>
<td>30.3</td>
</tr>
<tr>
<td>Short Answer</td>
<td>12</td>
<td>36.3</td>
</tr>
<tr>
<td>Matching</td>
<td>05</td>
<td>15.1</td>
</tr>
<tr>
<td>Analogy</td>
<td>05</td>
<td>15.1</td>
</tr>
<tr>
<td>Long answer</td>
<td>01</td>
<td>3.04</td>
</tr>
<tr>
<td>Total</td>
<td>33</td>
<td>100%</td>
</tr>
</tbody>
</table>
Table 4.4

Weight age to content in the Achievement Test

<table>
<thead>
<tr>
<th>Name of the Sub Unit</th>
<th>No. of Items</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>S.U – 1</td>
<td>01</td>
<td>3.1</td>
</tr>
<tr>
<td>S.U – 2</td>
<td>03</td>
<td>9.1</td>
</tr>
<tr>
<td>S.U – 3</td>
<td>02</td>
<td>6.1</td>
</tr>
<tr>
<td>S.U – 4</td>
<td>04</td>
<td>12.1</td>
</tr>
<tr>
<td>S.U – 5</td>
<td>04</td>
<td>12.1</td>
</tr>
<tr>
<td>S.U – 6</td>
<td>03</td>
<td>9.1</td>
</tr>
<tr>
<td>S.U – 7</td>
<td>04</td>
<td>12.1</td>
</tr>
<tr>
<td>S.U – 8</td>
<td>03</td>
<td>9.1</td>
</tr>
<tr>
<td>S.U – 9</td>
<td>03</td>
<td>9.1</td>
</tr>
<tr>
<td>S.U – 10</td>
<td>03</td>
<td>9.1</td>
</tr>
<tr>
<td>S.U – 11</td>
<td>03</td>
<td>9.0</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>33</strong></td>
<td><strong>100 %</strong></td>
</tr>
</tbody>
</table>

Blueprint of Achievement Test.

Blueprint is a three dimensional chart showing content, instructional objectives and form of questions the different forms of questions i.e.; objective type, analogy, matching type, short answer type and essay type are indicated in the Blueprint. The number inside the bracket indicated the marks and the numbers outside the bracket indicate the number of questions the blue print is given as Table 4.5
<table>
<thead>
<tr>
<th>Objective</th>
<th>Knowledge</th>
<th>Understanding</th>
<th>Application</th>
<th>Skill</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Content</td>
<td>M.C</td>
<td>M</td>
<td>A</td>
<td>S.A</td>
<td>E</td>
</tr>
<tr>
<td>S.U-1</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>1(2)</td>
<td>-</td>
</tr>
<tr>
<td>S.U-2</td>
<td>1(1)</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>1(1)</td>
</tr>
<tr>
<td>S.U-3</td>
<td>1(1)</td>
<td>-</td>
<td>-</td>
<td>1(2)</td>
<td>-</td>
</tr>
</tbody>
</table>
| S.U-4     | 1(1)      | -             | -           | -     | -     | -   | - | 1(1) | - | -   | - | - | -   | - | -   | - | - | -   | - | 4(6.5)
| S.U-5     | 1(1)      | -             | -           | -     | -     | -   | 1(1)| - | -   | - | -   | - | - | -   | - | -   | - | - | -   | - | 4(6.5)
| S.U-6     | 1(1)      | -             | -           | -     | -     | -   | 1(1)| - | -   | - | -   | - | - | -   | - | -   | - | - | -   | - | 3(4) |
| S.U-7     | 1(1)      | -             | -           | -     | -     | -   | 1(1)| - | -   | - | -   | - | - | -   | - | -   | - | - | -   | - | 4(5) |
| S.U-8     | 1(1)      | -             | -           | -     | -     | -   | 1(1)| - | 1(2)| - | -   | - | - | -   | - | -   | - | - | -   | - | 3(4) |
| S.U-9     | 1(1)      | -             | -           | -     | -     | -   | 1(1)| - | 1(2)| - | -   | - | - | -   | - | -   | - | - | -   | - | 3(4) |
| S.U-10    | 1(1)      | -             | -           | -     | -     | -   | 1(1)| - | 1(2)| - | -   | - | - | -   | - | -   | - | - | -   | - | 3(4) |
| S.U-11    | 1(1)      | -             | -           | -     | -     | -   | 1(1)| - | -   | - | -   | - | - | -   | - | 1(5)| - | - | -   | - | 3(7) |
| Total     | 10(10)    | -             | 2(4)        | 5(5)  | 5(5) | 3(6)| - | - | -   | - | 5(10)| 1(5)| - | -   | - | 2(5)| - | - | 33(50)|
Sample selected for the study

“Sampling is the process of selecting a number of individuals for a study in such a way that the individuals represent the larger group from which they were selected” (Gay, 1996). For studying any problem, it is difficult to study the whole population or universe. So, the process of ‘Sampling’ makes it possible to draw valid influences or generalizations on the basis of careful observations of variables within a relatively small proportion of the population. Cornell (1960) defines ‘Sampling’ as the process by which a relatively small number of individuals, objects or events is selected and analysed in order to find out something about the entire population or universe from which it was selected.

The sample selected for the study constitutes representative groups of Secondary school students of Karnataka (Class IX A Division and jX B Division) the sample of students were selected on the basis of Non-Probability Sampling technique.

Table 4.6
Sample selected for the study

<table>
<thead>
<tr>
<th>Sample</th>
<th>Name of the School</th>
<th>Locality</th>
<th>Sex</th>
<th>Total No of Students</th>
</tr>
</thead>
<tbody>
<tr>
<td>Experimental Group</td>
<td>R.V. Girls High School, Jayanagar, Bangalore IX ‘A’ Section</td>
<td>Urban</td>
<td>Female</td>
<td>50</td>
</tr>
<tr>
<td>Control Group</td>
<td>R.V. Girls High School, Jayanagar, Bangalore IX ‘B’ Section</td>
<td>Urban</td>
<td>Female</td>
<td>50</td>
</tr>
</tbody>
</table>
Collection of Data

Permission to conduct the experiment was obtained in advance from the school principal and the investigator personally conducted this classroom experiment. The procedure adopted for conducting the experiment is detailed below.

Comparing the initial ability of the Groups

In order to compare the two groups (experimental and control groups) the investigator administered the pre-test, for this an achievement test on biology was used and the test items assessed the basic knowledge in biology as entry behaviour. The scores on achievement test were tabulated and used for statistical treatment.

Exposition to Teaching Treatment

"After administering the pre-test, the experimental group was taught using Advance Organizer Model learning package. The control group was taught using Conventional Method.

Learning by the Experimental Group

The prepared learning package consisted of 11 Lesson plans. Each lesson was planned and presented according to syntax of Advance Organizer Model. The investigator taught each lesson along with necessary explanations, and instruction for a period of 40 minutes.

After learning each unit of the package, there was a session for discussion on the Advance Organizers and presentation of content. The students raised their doubts and the investigator offered the clarification and answered their queries. It was noticed that the students were very eager and curious in learning the topic. They
observed and analyzed the Advance Organizers presented and participated in all the activities mentioned in the learning package. They were encouraging to students i.e. about different phyla of invertebrates such as porifera, coelenterates, annelids, arthropods, ascheleminthes etc. This further motivated them to learn and explore more about invertebrates. The experimental instruction was completed in eleven periods of 40 min each and the group learned the learning package and interacted well in the class.

Learning by the Control Group

The same topics were also taught to the control group by the investigator. The investigator used the Conventional Lecture Method to explain the different concepts and taught these topics for the same duration. The investigator cleared all the doubts raised by the students in order to enable them to get good understanding about the areas taught. Care was taken to give equal time and effort to the control group as well as the experimental group. Thus every care was taken to make the experiment a reliable one.

Evaluation

Administration of Post-test

After completing the learning by the experimental and control groups, the achievement test (Post-test) on the topic “The Living world” was given to both the groups, to know effectiveness of Advance Organizer Model learning package on the achievement of Instructional objectives knowledge, understanding, application and skill.

The achievement test was administered to both the groups on the same day and response sheets were collected back by the investigator.
Scoring and consolidation of Data

In the experimental part of the study, the scores on the achievement test (Post-Test) were tabulated and used for statistical treatment.

Statistical techniques used for Analysis

- Independent sample student unpaired ‘t’ test was used to find whether there is any significant difference among the means of Pre-test and Post-test achievement scores of both the experimental and control groups under study.

- Friendman test was used to compare the variability of knowledge, understanding, application and skill objective in the experimental group. Pair wise comparison within the experimental group was done applying the Wilcoxon signed rank test and the same test was applied for the control group.

- Mann-Whitney test was used to compare the variability of knowledge, understanding, application and skill objectives between the experimental and the control group.