CHAPTER III

READING MATERIALS AND TESTS

The present study is conducted to study the gradual transformations on the three variables viz., step-size, reinforcement and response mode in programmed instruction. Preparation of programmed material is not the objective of the present study, hence, the investigator selected programmes in human physiology written by McGuigan (1965). The programmes chosen were modified and used for the various transformations on the variables.

3.1 Tools employed

The various tools considered necessary for the present study are-

a) Programmed Learning Material
b) Pre and Post - tests
c) A Science Aptitude Test

a) Programmed Learning Material

Four sections were selected from McGuigan's Biological Basis of Behaviour - A Programme 1965

The sections selected were-

i) The Ear (McGuigan pp 15-28)
ii) The Eye (McGuigan pp 29-43)
iii) Olfaction and Gustation (McGuigan pp 44-60)
iv) The Muscles (McGuigan pp 212-229)

The programme on 'the ear' had 105 frames, 'the eye' had 130...
frames 'Olfaction and Gustation' had 134 frames and the muscles' had 148 frames originally. These four sections were modified and rewritten to equate in terms of programme density, language difficulty and size of the frame. The four original programmes chosen had some lengthy frames that were broken down. Some difficult words that were thought not comprehensible by the students were omitted and replaced by simpler words. In the original programmes, at the end of each programme, some revision frames were provided. These were omitted in the modified versions. The density of the four rewritten programmes was maintained between 2 to 4. Table 3.1 shows the rewritten programme density and number of frames for the four sections chosen and modified.

<table>
<thead>
<tr>
<th>Sr No</th>
<th>Programme</th>
<th>Total Number of frames</th>
<th>Density</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>The Ear</td>
<td>108</td>
<td>.303</td>
</tr>
<tr>
<td>2</td>
<td>The Eye</td>
<td>111</td>
<td>305</td>
</tr>
<tr>
<td>3</td>
<td>Muscles</td>
<td>135</td>
<td>404</td>
</tr>
<tr>
<td>4</td>
<td>Olfaction &amp; Gustation</td>
<td>138</td>
<td>205</td>
</tr>
</tbody>
</table>

b) Pre and Post Tests:

The rewritten versions of the four sections chosen were taken as the basis, and for each programme corresponding 16 item pre and post tests were prepared. A total of four pre tests and four post tests were prepared (vide appendix I-VIII).

Science Aptitude Test:
A Science aptitude test was prepared by selecting items from Science talent search examination booklets prepared by 'National Council of Educational Research and Training' New Delhi. A total number of 50 items was chosen from the following years examinations-1964, 1966, 1968, 1969, 1970 and 1971. Care was taken to select only those items, whose content existed in the present Xth Standard science syllabus (Vide appendix IX).

3.2 Testing for Judging the Reliability and Validity of the Test

In PLM studies, rarely in the past effort has been made to establish validity and reliability of the pre-and post tests. However, the present investigator took prior care to establish validity and reliability of tests under normal testing conditions. Would the tests behave at least as good as normal tests was the question she pondered to answer. The 16 item pre-and post tests prepared for the four sections of the programme were tested for reliability and validity. For testing the reliability and validity, the four pre test items were clubbed together to form 'test-I'. Similarly, the four post test items were clubbed to form 'test-II', each having 64 items. Thus, test I represented all the four topics, in the same way test II represented.

These two tests-test I and test II were given on separate but successive days to a sample of 40 students studying in Xth Standard from "Basel Mission School; Dharwad. The subject matter in the programme selected was dealt in the Xth Standard Syllabus. Hence students studying in Xth Standard were chosen on the third
day the Science aptitude test was administered to the same sample of 40 students.

The data obtained from these tests were statistically analysed to get the reliability and validity coefficients of the tests.

I) Reliability of Pre-and Post Tests:

The reliability was computed using the split half technique, using the 'Spearman-Brown Prophecy Formula'. (Ferguson 1966 p. 378) The formula is

\[
r_{xx} = \frac{2r_{hh}}{1 + r_{hh}}
\]

First, between the two halves of the pre test, Pearson product moment correlation coefficient (r) was calculated using the formula

\[
r = \frac{\frac{\sum xy}{N} - \frac{\sum x \sum y}{N}}{\sqrt{\frac{\sum x^2 - \left(\frac{\sum x}{N}\right)^2}{N - 1}} \sqrt{\frac{\sum y^2 - \left(\frac{\sum y}{N}\right)^2}{N - 1}}}
\]

Likewise between the two halves of the post-test also r was obtained. Table 3.2-1 shows reliability coefficients calculated by split half technique abridged to full length using Spearman Brown formula. Where n = 40, (df = 38), r = .358 is significant at .01 level. The obtained values are very much higher and enough to assure safely that the pre and post tests are reliable under normal testing circumstances.
Table 3.2-1: Reliability Coefficients of Pre- and Post tests

<table>
<thead>
<tr>
<th>Tests</th>
<th>x-y</th>
<th>Mean 1</th>
<th>Mean 2</th>
<th>St. dev. 1</th>
<th>St. dev. 2</th>
<th>Rel of half tests</th>
<th>Rel of full tests</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N</td>
<td>(Mx)</td>
<td>(My)</td>
<td>(Sx)</td>
<td>(Sy)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pre-test</td>
<td>(set A)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>halves</td>
<td>194 65</td>
<td>12</td>
<td>15.5</td>
<td>3.3167</td>
<td>4.3185</td>
<td>0.6039</td>
<td>0.753</td>
</tr>
<tr>
<td>A1 &amp; A2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Post-test</td>
<td>(set B)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>halves</td>
<td>221 55</td>
<td>13 45</td>
<td>15.526</td>
<td>4.6041</td>
<td>3.8922</td>
<td>0.7109</td>
<td>0.831</td>
</tr>
<tr>
<td>B1 &amp; B2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

II) Reliability of Science Aptitude test:

The reliability of the Science aptitude test was computed using the split half technique in a similar fashion as discussed for pre- and post tests. Table 3.2-2 shows the details of the calculation of reliability coefficient. Where n=40, df=38, r= 0.358 is significant at 0.01 level. The obtained value is very much high to assure that the Science aptitude test is reliable under normal testing circumstances.
Table 3.2-2: Reliability Coefficient of Science Aptitude Test

<table>
<thead>
<tr>
<th>Tests</th>
<th>xy</th>
<th>Mean 1</th>
<th>Mean 2</th>
<th>St.de- 1</th>
<th>St.de- 2</th>
<th>Rel. of the half test</th>
<th>Rel. of the full test</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td></td>
<td>(Mx)</td>
<td>(My)</td>
<td>1 (Sx)</td>
<td>2 (Sy)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| Science Aptitude Test (set T) | 144.075 | 11.775 | 11.5   | 3.3652   | 3.4292   | 0.5466               | 0.767               |
| between halves T1 & T2        |        |        |        |          |          |                      |                      |

III) Validity of Pre- and Post Tests:

The Correlation coefficient was calculated using the Pearson product moment correlation formula as discussed earlier between the various tests. Table 3.2-3 gives Pearson r value obtained between (1) Science Aptitude test and Pre-test, (2) Post test and Science Aptitude test and (3) Pre-test and Post-test. The values are above + 0.358, for n=40, df=38, at 0.1 level.
Table 3.2-3: Validity of Pre and Post Tests, and Science Aptitude Test.

<table>
<thead>
<tr>
<th>Tests</th>
<th>x</th>
<th>y</th>
<th>Mean 1</th>
<th>Mean 2</th>
<th>St devi 1</th>
<th>St devi 2</th>
<th>Pearson</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N</td>
<td></td>
<td>(MX)</td>
<td>(MY)</td>
<td>(Sx)</td>
<td>(Sy)</td>
<td></td>
</tr>
<tr>
<td>Aptitude Test (Set T)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pre Test (Set A)</td>
<td>671</td>
<td>5</td>
<td>23.475</td>
<td>27.5</td>
<td>5.9749</td>
<td>6.8520</td>
<td>0.634</td>
</tr>
<tr>
<td>between A and T</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Post Test (Set B)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Aptitude Test (Set T)</td>
<td>711</td>
<td>275</td>
<td>23.475</td>
<td>28.975</td>
<td>5.9749</td>
<td>7.8628</td>
<td>0.662</td>
</tr>
<tr>
<td>between B and T</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pre Test (Set A)</td>
<td>832</td>
<td>5</td>
<td>28.975</td>
<td>27.5</td>
<td>7.8628</td>
<td>6.8520</td>
<td>0.662</td>
</tr>
<tr>
<td>Post Test (Set B)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>between A and B</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Thus the three tests were proved to be highly valid.

In addition the correlation coefficients between pre and post tests separately for each of the four programmes chosen were computed using the Pearson product moment correlation formula. The details are presented in Table 3.2-4.
<table>
<thead>
<tr>
<th>Programme</th>
<th>x</th>
<th>y</th>
<th>Pre-test</th>
<th>Post-test</th>
<th>Pre-test</th>
<th>Post-test</th>
<th>Pearson</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N</td>
<td>Mean 1 (MX)</td>
<td>Mean 2 (MY)</td>
<td>St dev 1 (Sx)</td>
<td>St dev 2 (Sy)</td>
<td>r</td>
<td></td>
</tr>
<tr>
<td>The Ear</td>
<td>65 325</td>
<td>6 878</td>
<td>9 00</td>
<td>1 9779</td>
<td>3 0903</td>
<td>0.560</td>
<td></td>
</tr>
<tr>
<td>The Eye</td>
<td>66 5</td>
<td>7.8536</td>
<td>7.95</td>
<td>2.8875</td>
<td>2.5685</td>
<td>0.548</td>
<td></td>
</tr>
<tr>
<td>OLF &amp; Gust</td>
<td>47 7</td>
<td>6.525</td>
<td>6.9</td>
<td>2.3344</td>
<td>2.8</td>
<td>0.410</td>
<td></td>
</tr>
<tr>
<td>Muscles</td>
<td>36 25</td>
<td>6 05</td>
<td>5 65</td>
<td>2 2798</td>
<td>2.2533</td>
<td>0.402</td>
<td></td>
</tr>
</tbody>
</table>

The values are above +0.358, for n = 40, d f =38, at 01 level.

The section wise pre and post tests which are in fact short (i.e. each 16 item long) were also found to have significant validity when used following normal teaching course. This is to be sure that even the short tests behaved as good achievement tests under normal testing circumstances.

The coefficient of reliability and validity reported so far are enough to conclude that the tests to be used following the programmes in this study are quite dependable and good.

3.3 Establishing Programme Equivalence
To test the equivalence of the four programmes rewritten with modifications, the rewritten programmes along with their respective pre and post tests were administered to 24 students studying in Xth standard from 'St Josephs Convent School' Dharwad. The sample consisting of 24 students were grouped into four groups based on the marks obtained in science at IXth standard final examinations. Thus four groups of six students each matched for one to one correspondence in terms of marks were obtained. The sitting arrangement in the class consisted of four rows and each group was in one row with sufficient distance between individual students. Group I students went through the programme on 'The Ear', Group II students went through the programme on 'The Eye', Group III students went through the programme on 'The Muscles', and Group IV students went through the programme on 'Olfaction and Gustation'.

The method followed in collecting the data for testing programme equivalence was administering the pre test then the programme and then the post test.

The mean gain scores obtained i.e. the mean difference between the marks in the pre test and post test were subjected to statistical test of significance of difference between the means using the t-test. Table 3.3-1 presents computational details and the respective 't’ values.
<table>
<thead>
<tr>
<th>Programme</th>
<th>Mx</th>
<th>My</th>
<th>Sx</th>
<th>Sy</th>
<th>rxy</th>
<th>SD</th>
<th>t-diff</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between I &amp; II</td>
<td>6.8333</td>
<td>4.1667</td>
<td>2.9107</td>
<td>2.9674</td>
<td>-0.286</td>
<td>2.827</td>
<td>0.94</td>
</tr>
<tr>
<td>Between I &amp; III</td>
<td>6.8333</td>
<td>6.5000</td>
<td>2.9107</td>
<td>4.4251</td>
<td>-0.045</td>
<td>2.257</td>
<td>0.15</td>
</tr>
<tr>
<td>Between I &amp; IV</td>
<td>6.8333</td>
<td>5.0000</td>
<td>2.9108</td>
<td>3.0000</td>
<td>0.802</td>
<td>0.761</td>
<td>2.41</td>
</tr>
<tr>
<td>Between II &amp; III</td>
<td>4.1667</td>
<td>6.5000</td>
<td>2.9674</td>
<td>4.4253</td>
<td>0.869</td>
<td>0.960</td>
<td>-2.43</td>
</tr>
<tr>
<td>Between II &amp; IV</td>
<td>4.1667</td>
<td>5.0000</td>
<td>2.9674</td>
<td>3.0000</td>
<td>-0.112</td>
<td>2.162</td>
<td>-0.39</td>
</tr>
<tr>
<td>Between III &amp; IV</td>
<td>6.5000</td>
<td>5.0000</td>
<td>4.4231</td>
<td>3.0000</td>
<td>-0.239</td>
<td>1.927</td>
<td>0.78</td>
</tr>
</tbody>
</table>

Table 3.3-1: Testing significance of difference between gain means among the programmes on I- The Ear, II- The Eye, III- The Muscles and IV- Olfaction and Gustation.

\[ r_{xy} = \frac{\Sigma xy}{N} \]

\[ SD = \sqrt{\frac{\Sigma (x - \bar{x})^2}{N - 1}} \]

The tabled t values for df= 5 at 0.05 level is 2.571 and at 0.01 level is 4.03. As the obtained t ratio is smaller than the table t ratio at both t 0.05 and t 0.01 level, we conclude that there is no significant difference between the gain means, obtained by virtue of using the four programmes. The results obtained prove that the four programmes selected and modified were equal and did not differ significantly, in terms of learning gain each caused.

3.4 Treatment Combinations
The three variables chosen for transforming a programme in the study were Step-size, Reinforcement and Response mode. Two levels of Step-size (small step and large step), three levels of Reinforcement (every response KCR, every fifth response KCR, No KCR) and four levels of Response Mode (Written, underlined, thought and evoked, and thought) were identified. The Step size was designated as factor A, reinforcement as factor B, and response mode as factor C. The transformations involved variations touching the levels in each factor mentioned above.

3.5 Explanation of the Variations attempted

A Step-size:

In step size the two variations attempted are two chunk step and seven chunk step.

Two Chunk Step:

Two chunks are taken as small step size. A chunk consists of one basic block or fragment of information to be taught, made up of one to two sentences followed by one to two questions asked or words deleted and one two word answers. Each chunk (Furukawa, 1970) will require 10/15 seconds to be read.

Seven Chunk Step

Seven chunks are taken as large step-size. A chunk consists of one to two sentences followed by one to two questions asked or words deleted and one two word answers. Seven chunk consist of
seven sentences followed by seven questions asked or words deleted requiring seven word response. Each seven chunk (Furukawa 1970) step will require about 70 seconds to read

**Reinforcement:**

In reinforcement the three variations attempted are continuous KCR, intermittent KCR and subsequent task KCR

**Continuous KCR:**

Reinforcement is in the form of knowledge of correct response (KCR), presented in the written form on the left hand margin to all the responses. It is a condition that is built into the programmed learning material itself, i.e., 'Extrinsic' to the learner.

**Intermittent KCR:**

Reinforcement is given to only a few responses using fixed ratio schedule, i.e., KCR to every fifth response is provided, the pupils are directed to verify their answers to those responses without KCR in the subsequent task. For every fifth response only direct reinforcement is provided and for the remaining responses no direct reinforcement is provided by the programmed material.

**Subsequent task KCR:**

The reinforcement is not provided directly by the programme in the form of KCR, but KCR is obtained by the students.
themselves by reading the subsequent tasks i.e., 'intrinsic' to the learner

C. Response Mode:

In response modes, the four variations attempted are overt written, overt underlined, covert-subsequent evoking, and covert-not expressed

Overt Written:

The responses to information stimulus in each frame are to be written on a separate sheet provided.

Overt Underlined:

Responses to stimulus in each frame are asked not to be written but only thought of and these thought responses are to be underlined in the first half of the next frame.

Covert Subsequent evoking:

The response to each frame are thought of, but not written and these responses are made more to be thought of or provoked by a question or sentence following each frame.

Covert not expressed:

The responses to each frame are thought, but not written underlined or questioned.

Diagrammatic Representation of the Design

Accordingly a 2x3x4 factorial design with repeated measures
on the third factor was decided to be employed. Repeated measures on the fourth factor became possible as the subject matter (i.e., the ear, the eye, olfaction, and gustation, and muscles) differed in the repetitions.

The design employed is shown diagramatically in Fig 3.501.

![Diagram](image)

**FIGURE 3.501. Diagramatic representation of the design employed.**

### 3.9 Distribution of programmes to treatment combination

Taking these four modified versions of the programme that were equal and did not differ significantly in terms of learning gain, 24 different types of programmes (i.e., touching each of the possible 2x3x4 combinations) were prepared. The four programmes selected were to be transformed into 24 different types. First they were randomly distributed to the 24 cells, as shown in figure 3.601.
Figure : 3.601 Distribution of the programmes to the 24 cells
3.7 **Studies supporting the 24 treatment cells**

Review of research shows some studies in support of the 24 treatment cells. The studies supporting programme transformations for the 24 cells is indicated according to the factor wise levels in Table 3.7-1.

**Table 3.7-1 Some studies supporting factorwise levels used for transformation of programmes.**

<table>
<thead>
<tr>
<th>Variables(factors)</th>
<th>Levels</th>
<th>Studies</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>b) Large step size</td>
<td>ii) Sendek Mary Ellen (1978)</td>
</tr>
<tr>
<td>2) Reinforcement</td>
<td>a) Every response KCR</td>
<td>i) B F Skinner (1958)</td>
</tr>
<tr>
<td></td>
<td>b) Every fifth response KCR</td>
<td>ii) Mc Cormack et al (1963)</td>
</tr>
<tr>
<td></td>
<td>c) No KCR</td>
<td>iii) Mohan &amp; Mann (1970)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>iv) Anderson (1970)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>v) Peter Kuo Hsuing (1977)</td>
</tr>
<tr>
<td>3) Response Mode</td>
<td>a) Written response</td>
<td>i) B.F, Skinner (1958)</td>
</tr>
<tr>
<td></td>
<td>b) Response to be underlined</td>
<td>i) John Barlow (1960)</td>
</tr>
<tr>
<td></td>
<td>c) Responses to be thought &amp; evoked</td>
<td>i) Evans, Homme and Glaser (1960)</td>
</tr>
<tr>
<td></td>
<td>d) Thought responses</td>
<td>ii) Smith D.E P (1959)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>i) Shah (1971)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>ii) Stoburow &amp; Walker (1982)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>iii) Leith &amp; Ghuman (1967)</td>
</tr>
</tbody>
</table>

For details of studies supporting the present study refer to chapter II.
3.8 Cell descriptions

For convenience of describing, the cells are numbered as shown in figure 3.601. Each cell refers to one treatment combination of step size, reinforcement and response mode levels.

Cell 1:

The cell will get a transformed programme having a treatment combination of written responses, providing knowledge of correct response (KCR) for every response and small step size presentation. The programme for this cell was written taking the three variations mentioned above and is on 'the ear' as per the distribution made in figure 3.601. The reading material for this cell has 105 frames written in small step size, requiring the pupils to write their answers for each response and each response was provided with KCR. The following frames forming a part of the programme will make this clear.

THE EAR

1. One type of energy that strikes on an organism is what we call sound.

2. The organ that is particularly sensitive to sound is the ear.

3. When an object, such as a tuning fork or a bell which a part of a persons
surrounding is _________ it vibrates

Struck 4 When a turning fork vibrates, it sets off sound _______

Cell 2:

The cell will get a transformed programme having a treatment combination of responses to be underlined in the first half of the next frame, providing knowledge of correct response (KCR) for every response and small step presentation; and the programme, is on 'the eye' as per the distribution made in figure 3 601 The reading material for this cell has 103 frames written in small step size, requiring the pupils to underline their answers in the first half of the next frame, and each frame was provided with KCR The following frames forming a part of the programme will make this clear

THE EYE

1 Some objects emit visual stimulus this _________ is a form of 'radiant energy'

stimulus 2 Consider the various stimulus objects in a persons surrounding that emits radiant energy A stimulus object such as a light bulb itself produces the radiant _________ that it emits.
3. Radiant energy is either produced, or reflected. A stimulus object, such as a light bulb, itself produces the radiant ________ that it emits.

4. Other stimulus objects however do not produce radiant energy, but rather they reflect ________ energy coming from other sources.

Frames 2, 3, and 4 have words 'Stimulus', 'energy' and 'energy' which are responses to frame 1, 2, and 3 and are required to be underlined by the responding student.

**Cell 3:**

The cell will get a transformed programme having a treatment combination of responses to be thought and subsequently followed by a sentence which provokes the pupils to think of the expected answer. Providing knowledge of correct response (KCR) for every response and small step size, presentation. The programme is on 'the muscles' as per the distribution made in figure 3 601. The reading material prepared for this cell has 108 frames written in small step, in which responses are thought and the pupils are provoked towards the correct answer by a sentence that follows each frame, and each response is provided with KCR. The following frames forming a part of the programme used will make this clear.
MUSCLES

1. A muscle is a bundle or collection of tiny _____ fibres.
   For example a nerve is similar to a muscle., a nerve is a bundle or collection of tiny nerve fibres.

2. In figure 1 we see a muscle fibre, muscle fibres are collected or bound together to form a ________.

Figure 1
Study figure 1

3. In figure 1 we see a diagram of one kind of muscle ________

There are three types of muscle fibre based on the appearance and function of their cells.
When a nerve impulse arrives at a muscle it causes a number of muscle fibres to contract. Contract means to shorten.

Cell 4.

The cell will get a transformed programme having a treatment combination of responses to be thought, providing knowledge of correct response (KCR) for every response and small step size presentation. The programme is on 'Olfaction and Gustation', as per the distribution made in figure 3. The reading material for this cell has 138 frames written in small step size, requiring the pupils to think answers for each response, and each response is provided with KCR. The following frames forming a part of the programme used will make this clear.

**OLFACTION AND GUSTATION**

1. In this part of the programme let us consider how the receptor cells in the nose respond to a smell.

2. The nose contains receptor cells that are particularly sensitive to a smell.

3. 'Olfaction' is the technical term for the sense of smell.
When we want to talk about the sense of smell we will usually use the term "smell".

Cell 5:

The cell will get a transformed programme having a treatment combination of written responses, providing knowledge of correct response (KCR) for every fifth response and small step size presentation. The programme for this cell is on "the eye" as per the distribution made in figure 3. The reading material for this cell has 111 frames written in small step size, requiring the pupils to write their answers for each frame and every fifth response is provided with KCR. The following frames forming a part of the programme to be used will make this clear.

**THE EYE**

1. Some visual stimulus, objects emit light, this _______ is a form of "Radiant Energy".

2. A light bulb is an example of a visual stimulus object that emits radiant _______.

3. There are various visual stimulus objects,
in a person's surrounding, that emits _______ energy.

4 A stimulus object, such as a light bulb, itself produces the radiant ________ that it emits.

5. Other visual stimulus objects, however, do not produce radiant ________

6 But rather they reflect ________ energy coming from other sources

Cell 6:

The cell will get a transformed programme having a treatment combination of responses to be underlined in the first half of the next frame, providing knowledge of correct response (KCR) to every fifth response and small step presentation. The programme is on "the ear" as per the distribution made in figure 3.601. The reading material for this cell has the programme written in small step size, requiring the pupils to underline their answers in the first half of the next frame and every fifth response is provided with KCR. The following frames forming a part of the programme to be used will make this clear:

THE EAR

1 One type of energy that strikes on an organism is what we call sound ________

waves

2 Sound waves strike a particular organ called
3 The ear receives sound waves, when an object, such as a tuning fork is it vibrates

4 When a tuning fork is struck it vibrates. It sets off sound ________

5 Figure 1. shows how a sound wave is produced by a vibrating __________ fork

![Sound wave](image)

Figure 1

6. The vibrating tuning fork is sending __________ ________ through the air

It is to be noted that the words 'waves, ear', 'struck', 'wave', and 'tuning' appearing in the first part of frames 2, 3, 4, 5 and 6 are to be underlined as responses respectively to frames 1, 2, 3, 4 and 5.
Cell 7:

The cell will get a transformed programme having a treatment combination of responses to be thought and subsequently followed by a sentence which provokes the pupils to think of the expected answer, providing knowledge of correct response (KCR) for every fifth response and small step size presentation. The programme is an 'Olfaction and Gustation', as per the distribution made in figure 3. The reading material prepared for this cell has 135 frames written in small steps in which the responses are thought and the pupils are provoked towards the correct answer by a sentence that follows each frame and every fifth response is provided with KCR. The following frames forming a part of the programme used will make this clear.

OLFACTION AND GUSTATION

1. In this part of the programme, let us, consider how the receptor cells in the nose respond to a __________

   Smell is that which is noticed by the nose

2. The nose contains receptor cells that are particularly sensitive to a __________

   By the nose we smell, sensitive means quick to receive.

3. 'Olfaction; is the technical term for the sense of __________
Technical terms are those used and understood by persons having a special knowledge of a particular subject.

4 When we want to talk about the sense of smell, we will usually use the term _______. Olfactory refers to smell.

5 When talking about smell, we will refer to 'Olfactory' stimulus, instead of smell _________.

Stimulus refers to anything that rouses to activity.

stimulus 6

Cell 8:

The cell will get a transformed programme having a treatment combination of response to be thought, providing knowledge of correct response (KCR) for every fifth response, and small step size, presentation. The programme is on 'muscles' as per the distribution made in figure 3 601. The reading material for this cell has 135 frames written in small step size, requiring the pupils to think the answers for each frame, and every fifth response is provided with KCR. The following frames forming a part of the programme used will make this clear.

MUSCLES

1 A nerve is similar to a muscle. A nerve is
a bundle or collection of tiny nerve fibre, a muscle is a bundle or collection of tiny

fibres

Figure 1 A muscle fibre

2. In figure 1 we see a diagram of one kind of

 fibre

3. When a nerve impulse arrives at a muscle it

causes a number of muscle __________ to

contract

4. This is because a single nerve fibre joins

several _______ fibres

5. In figure 2 we see an example of how a

single nerve fibre joins with several

___________ ___________
The cell will get a transformed programme having a treatment combination of responses to be written, providing no knowledge of correct response for any responses and small step size presentation. The programme is on 'Olfaction and Gustation' as per the distribution made in figure 3 601. The reading material for this cell has 138 frames written in small step size, requiring the pupils to write their answers, and for each response no KCR is provided. The following frames forming a part of the programme used will make this clear

OLFACTION AND GUSTATION

1 In this part of the programme let us consider how the receptor cells in the nose respond to a __________
2 The nose contains receptor cells that are particularly sensitive to a 

3 The nose contains receptor cells that are particularly sensitive to a 

4 'Olfaction' is the technical term for the sense of 

5 When we want to talk about the sense of smell, we will usually use the term 

---

**Cell 10:**

The cell will get a transformed programme having a treatment combination of responses to be underlined in the first half of the next frame, no KCR for any responses and small step presentation. The programme is on 'the muscles' as per the distribution made in figure 3 601. The reading material for this cell has 133 frames written in small step size requiring the pupils to underline their answers in the first half of the next frame and no KCR for any responses. The following frames forming a part of the programme used will make this clear.

**THE MUSCLES**

1 A nerve is similar to a muscle, a nerve is a bundle or collection of tiny nerve fibres, a muscle is a bundle or collection of tiny fibres
Figure 1 shows a muscle fibre. In figure 1, we see a diagram of one kind of _______ fibre.

Figure 1: A muscle fibre

When a nerve impulse arrives at a muscle, it causes a number of muscle _______ to contract.

This is because several muscle fibres are joined by a single _______ fibre.

The words 'muscle', 'muscle', 'fibre', appearing in the first part of frames 2, 3, and 4 are required to be underlined as responses respectively to frames 1, 2, and 3.

Cell 11:

The cell will get a transformed programme having a treatment combination of responses to be thought and subsequently followed by a sentence which provokes the pupils to think of the expected
answer, no KCR to any responses and small step size presentation.
The programme is on the 'eye' as per the distribution made in figure 3 601. The reading material prepared for this cell, has 106 frames written in small steps in which responses are thought and the pupils are provoked towards the correct answer by a sentence that follow each frame, and no KCR is provided to any frames. The following frames forming a part of the programme used will make this clear.

THE EYE

1. Some visual stimulus objects emit light, this ______ is a form of 'radiant energy'.
Visual stimulus is anything that arouses the eye to action.

2. A light bulb is an example of a visual stimulus object that emits radiant ______.
Emit means to give out, light is a form of energy.

3. There are various stimulus objects, in a person's surrounding, that emits ______ energy.
A light bulb emits radiant energy.

Cell 12:

The cell will get a transformed programme having treatment.
combination of responses to be thought. No KCR and small step size presentation. The programme is on 'the ear' as per the distribution made in figure 3 601. The reading material for this cell has 108 frames written in small step size, requiring the pupils to think of the answers for each response, and no KCR is provided to any response. The following frames forming a part of the programme used will make this clear.

THE EAR

1. One type of energy that strikes on an organism is what we call sound ________.

2. The organ that is particularly sensitive to sound ________ is the ear.

3. When an object, such as a tuning fork or a bell which is part of a person's surrounding is ________, it vibrates.

4. When a tuning fork vibrates, it sets off sound ________.

Cell 13.

The cell will get a transformed programme having a treatment combination of written responses, providing knowledge of correct response (KCR) for every response and large step size presentation. The programme for this cell is on 'olfaction and gustation' as per the distribution made in figure 3 601. The reading material for this cell has 17 frames written in large
step size requiring the pupils to write their answers for each response and each response is provided with KCR The following frames forming a part of the programme used will make this clear.

OLFACTION AND GUSTATION

1. In this part of the programme let us consider how the receptor cells in the nose respond to a smell, the nose contains receptor cells that are particularly sensitive to a smell. 'Olfaction' is the technical term for the sense of smell. When we want to talk about the sense of smell, we usually use the term 'Olfaction' while talking about smell, we refer to 'Olfactory' stimuli instead of smell stimuli. Thus, we say that the ________ is particularly _________ to ________ stimuli. The type of ________ that excites the ________ is the ________ stimulus.

- nose
- sensitive
- olfactory
- stimulus
- nose
- olfactory

2.

Cell 14:

The cell will get a transformed programme having a treatment.
combination of responses to be underlined in the first half of the next frame, providing knowledge of correct responses (KCR) for every response and large step size presentation. The programme is on 'the muscle' as per the distribution made in figure 3.601. The reading material for this cell has 19 frames written in large step size, requiring the pupils to underline their answers in the first half of the next frame and each response is provided with KCR. The following frames will make this clear.

**MUSCLE**

1. A nerve is similar to muscle, a nerve is a bundle or collection of tiny nerve fibres, a muscle is a bundle or collection of tiny muscle fibre. In figure 1 we see the diagram of one kind of muscle fibre.

![Figure 1: A muscle fibre](image)

When a nerve impulse arrives at a muscle it causes a number of muscle fibres to
contract. This is because a single nerve fibre joins several muscle fibres. In figure 2 we see an example of how a single nerve fibre joins with several muscle fibres

Thus, a nerve fibre causes a number of muscle fibres to contract. Let us now see what happens when a muscle fibre receives a nerve impulse. In figure 3 we see an enlarged diagram of a muscle fibre.
We see that in the normal resting state the muscle fibre has positive ions on the outside of its semi permeable membrane. Negative ions are found on the inside of the semi permeable membrane when a nerve fibre arrives at a single muscle fibre, this balance between ions on the and ions on the is disturbed.

The words 'nerve fibre', 'muscle fibre', 'single', 'muscle fibre' and 'contract' are the words to be underlined in the first half of frame 2, as responses to frame 1.

Cell 15:

The cell will get a transformed programme having a treatment combination of responses to be thought and subsequently followed.
by a sentence which provokes the pupils to think of the expected answer, providing knowledge of correct responses (KCR) for every response and large step size presentation. The programme for this cell is on 'the eye' as per the distribution made in figure 3. It has 16 frames written in large step in which responses are thought and the pupils are provoked towards the correct answer by a sentence that follows each frame, and each response is provided with KCR. The following frames forming a part of the programme used will make this clear.

THE EYE

1. Some visual stimulus objects emit light, this light is a form of 'radiant energy'. A light bulb is an example of a visual stimulus object that emits radiant energy. There are various visual stimulus objects in a person's surrounding that emit radiant energy. A stimulus object such as a light bulb, itself produces the radiant energy that it emits. Other visual stimulus objects, however, do not produce but rather they reflect coming from other sources. Some objects, for example, a door does not produce light in the form of radiant energy, but they reflect it coming from other sources.
objects  2.
radiant energy
radiant energy
sources

Cell 16:
The cell will get a transformed programme having a treatment combination of responses to be thought, providing knowledge of correct response (KCR) for every response and large step size presentation. The programme is on 'the ear' as per the distribution made in figure 3 601 having 16 frames written in large step size, requiring the pupils to think the answers for each frame, and each response is provided with KCR. The following frame forming a part of the programme used will make this clear.

THE EAR

1. One type of energy that strikes on an organism is what we call sound waves. The organ that is particularly sensitive to sound wave is the ear. When an object, such as a tuning fork or a bell which is part of a person's surrounding is struck it vibrates. When a tuning fork vibrates, it sets off sound. Figure 1 shows a vibrating ________ The vibrating ________is sending ________ through the ________.
Cell 17:

The cell will get a transformed programme having a treatment combination of written responses, providing knowledge of correct responses (KCR) for every fifth response and large step size presentation. The programme for this cell is on 'the ear' as per the distribution made in figure 3.601 having 16 frames written in large step size, requiring the pupils to write their answers for each response and every fifth response is provided with KCR. The following frames forming a part of the programme used will make this clear.

THE EAR

1. One type of energy that strikes on an organism is what we call sound waves. The organ that is particularly sensitive to
sound waves is the ear when an object, such as a tuning fork or a bell which is part of a person's surrounding is struck it vibrates. When a tuning fork vibrates, it sets off sound __________. Figure 1 shows a vibrating __________ __________. The vibrating __________ is sending __________ __________ through the ____________ waves 2.

It is to be noted here that frame 1 in the above cell has 7 responses to be given and only to the 1st and 5th response, KCR is provided.

Cell 18:

The cell will get a transformed programme having a treatment combination of responses to be underlined in the first half of the next frame, providing knowledge of correct response (KCR) to every fifth response and large step size presentation. The programme is on 'the eye' as per the distribution made in figure 3 601 having frames written in large step size requiring the pupils to underline their answers in the first half of the next frame and every fifth response is provided with KCR. The following frames forming a part of the programme used will make
1. Some visual stimulus objects emit light, this light is a form of 'Radiant Energy'. A light bulb is an example of a visual stimulus object that emits radiant energy. There are various visual stimulus objects in a person's surroundings that emit radiant energy. There are various stimulus objects in a person's surrounding, that emits radiant energy. A stimulus object such as a light bulb, itself produces the radiant energy that it emits. Other visual stimulus objects, however, do not produce ___________ But rather they reflect ___________ energy coming from other ___________.

2. A desk is an example of a stimulus object that reflects, rather than emits radiant energy. This radiant energy is reflected from other sources. A light bulb in a room produces ___________.

The words 'object', 'radiant', 'energy', 'radiant', 'energy', and 'sources' are to be
Call l&i

The cell will get a transformed programme having a treatment combination of responses to be thought and subsequently followed by a sentence which provokes the pupils to think of the expected answer, providing knowledge of correct response (KCR) for every fifth response and large step size presentation. The programme is on 'the muscle' as per the distribution made in figure 3 601 having 18 frames written in large steps in which the responses thought and the pupils are provoked towards the correct answer by a sentence that follows each frame and every fifth response is provided with KCR. The following frames forming a part of the programme used will make this clear.

MUSCLES

1  A nerve is similar to a muscle, a nerve is a bundle or collection of tiny nerve fibres, a muscle is a bundle or collection of tiny muscle fibres. In figure 1 we see a diagram of one kind of muscle fibre.

Figure 1
When a nerve impulse arrives at a muscle it causes a number of muscle fibres to contract. This is because a single nerve fibre joins several muscle fibres. In figure 2 we see an example of how a single \underline{nerve fibre} joins several \underline{muscle fibres}. Thus a \underline{nerve fibre} causes a number of \underline{muscle fibres} to contract.

Study figure 2 and note how a single nerve fibre joins several muscle fibres.

\underline{Cell 20:}

The cell will get a transformed programme having a treatment combination of responses to be thought, providing knowledge of correct response (KCR) for every fifth response. And large step.
size presentation The programme is on 'olfaction and gustation' as per the distribution made in figure 3. The reading material for this cell has 16 frames written in large step size, requiring the pupils to think of the answer for each frame, and every fifth response is provided with KCR. The following frames forming a part of the programme used will make this clear.

OLFACTION AND GUSTATION

1. In this part of the programme let us consider how the receptor cells in the nose respond to a smell, the nose contains receptor cells that are particularly sensitive to a smell.

'Olfaction' is the technical term for the sense of smell. When we want to talk about the sense of smell, we usually use the term Olfaction. While talking about smell, we refer to 'Olfactory' stimuli instead of smell stimuli. Thus, we say that the ________ is particularly ________ to ________ stimuli. The type of ________ that excites the ________ is the ________ stimulus.

2. 

nose

nose
Cell 21:

The cell will get a transformed programme having a treatment combination of written responses, providing no KCR for any responses and large step size presentation. The programme is 'the eye' as per the distribution made in figure 3 601 having 16 frames, written in large step size, requiring the pupils to write their answers, and no KCR is provided for the responses. The following frames forming a part of the programme used will make this clear.

THE EYE

1. Some visual stimulus objects emit light, this light is a form of 'Radiant Energy'. A light bulb is an example of a visual stimulus object that emits radiant energy. There are various visual stimulus objects in a person's surrounding that emit radiant energy. A stimulus object such as light bulb, itself produces the radiant energy that it emits. Other visual stimulus _________ however, do not produce _________ _________. But rather they reflect _________ _________ coming from other_________.

2. For example, a light bulb in a room produces
The cell will get a transformed programme having a treatment combination of responses to be underlined in the first half of the next frame, no KCR for any response and large step size presentation. The programme is on 'olfaction and gustation' as per the distributions made in figure 3 601 and has 20 frames written in large step size requiring the pupils to underline their answers in the first half of the next frame and no KCR for any responses. The following frames forming a part of the programme used will make this clear.

**OLFACTION AND GUSTATION**

1. In this part of the programme let us consider how the receptor cells in the nose respond to a smell, the nose contains receptor cells that are particularly sensitive to a smell. 'Olfaction' is the technical term for the sense of smell. When we want to talk about the sense of smell we usually use the term Olfaction. While talking about smell, we refer to 'Olfactory' stimuli instead of smell stimuli. Thus, we say that the ______ is particularly ______ to ________ stimuli. The type of _______ that exerts the nose is the _______ _______
The nose is the organ that is sensitive to smell stimulus. The nose is excited by smell or Olfactory Stimulus. A number of stimulus objects in our surrounding gives off odours.

The words 'nose', 'sensitive', 'smell', 'stimulus', 'Olfactory' and 'stimulus', appearing in the first part of frame 2, are the words to be underlined as responses to frame 1.

Cell 23:

The cell will get a transformed programme having a treatment combination of responses to be thought and subsequently followed by a sentence which provokes the pupils to think of the expected answer, no KCR to any responses and large step size presentation.

The programme is on 'the ear' as per the distribution made in figure 3 601, and has 16 frames written in large steps in which responses are thought and the pupils are provoked towards the correct answer by a sentence that follows each frame, and no KCR for any responses. The following frames forming a part of the programme used will make this clear.

THE EAR

1. One type of energy that strikes on an organism is what we call sound waves, the organ that is particularly sensitive to
sound waves is the ear. When an object, such as a tuning fork or a bell, which is part of a person's surroundings is struck, it vibrates. When a tuning fork vibrates, it sets off sound waves. Figure 1 shows a vibrating tuning fork. The vibrating tuning fork is sending sound waves through the air.

Figure 1
Study figure 1 carefully and answer

Cell 24:
The cell will get a transformed programme of responses to be thought. No KCR and large step size presentation. The programme is on 'the muscle' as per the distribution made in figure 3.601, and has 18 frames written in large step size, requiring the pupils to think of the answers for each response, and no KCR is provided to any response. The following frames forming a part of the programme used will make this clear.
MUSCLES

A nerve is similar to a muscle, a nerve is a bundle or collection of tiny nerve fibres, a muscle is a bundle or collection of tiny muscle fibres. In figure 1 we see a diagram of one kind of muscle fibre. When a nerve impulse arrives at a muscle it causes a number of muscle fibres to contract. This is because a single nerve fibre joins several muscle fibres.

Figure 1

In figure 2 we see an example of how a single __________ __________ joins with several __________ __________. Thus, a __________ nerve fibre causes a number of __________ __________ to __________
Thus 24 types of reading materials, samples of which are presented so far was prepared by the investigator. Each reading material roughly has 12-15 typed sheets of matter. Including all the 24 reading materials prepared in the appendix which amounts to roughly 288-360 pages was found unfeasible. For further reference they can be obtained from the investigator if felt necessary.

Taking these 24 types of reading materials along with their respective pre and post tests the data in this study proper were collected. Only five programme (cell 3, 5, 15, 16, and 22) with respective pre- and post tests have been appended in full. This along with samples described so far gives the idea needed for the purpose of understanding treatments employed in the study.