

CHAPTER 3
RESEARCH METHODOLOGY

CHAPTER-III RESEARCH METHODOLOGY

3.1.0 Introduction

Research methodology is the specific procedures or techniques used to identify, select, process, and analyze information about a topic. In a research paper, the methodology section allows the reader to critically evaluate a study's overall validity and reliability. The methodology section answers two main questions: How was the data collected or generated? How was it analyzed?

In this study, quantitative methodology was used to collect and analyze the data obtained from all the respondents.

3.2.0 Sample

A sample is a small portion of a population selected for observation and analysis. It is a collection consisting of a part of subset of population. The sampling technique to be used for present study will be 'Purposive Sampling' because it is focussed on class 9 students of a secondary school situated in Bhopal.

The sample comprised of 40 students of a public school of class 9.

3.3.0 Research Design

Experimental Research Design is used for the present study. The experimental research is a scientific approach to research, where one or more independent variables are manipulated and applied to one or more dependent variables to measure their effect on the latter. The effect of the independent variables on the dependent variables is usually observed and recorded over some time, to aid researchers in drawing a reasonable conclusion regarding the relationship between

these 2 variable types. A pretest-posttest design is usually a quasi-experiment research design where participants are studied before and after the experimental manipulation. **Quasi-experimental** simply means participants are not randomly assigned. It is possible to have a control group, or a group who doesn't receive the manipulation. In a pretest-posttest design, there is only one group and all of them are in the experimental condition.

3.4.0 Research Method

Quantitative research method is used to determine the cause and effect relationship between the variables. It is easier to interpret or infer relationships between the independent and dependent variables as they can manipulate the independent variable and its effect on dependent variable can be seen.

3.5.0 Research tools

The research tools were developed by the researcher in order to fulfill the criterion of the research being conducted. Data is collected by presenting quiz and questionnaire to the students after intervention of the ICT as a pedagogical tool to measure and compare their achievement and interest in the subject biology.

3.5.1 **Quiz:** The quiz consisted of 25 questions including fill in the blanks, multiple choice questions and one words from the 3 chapters from biology i.e. Fundamental unit of Life, Tissues, Diversity in living organisms in order to measure the level of achievement of learners.

Instructions for the quiz: Each question carries one mark. It is compulsory to attempt all questions. There will be no mark to be given on wrong answers. Tick a mark on the correct answer for each question.

3.5.2 Questionnaire: Self-made questionnaire to determine the interest of learners in teaching-learning biology through ICT as a pedagogical tool. It consist of 10 no. of inventories based on 3 point Likert scale i.e. Yes, No, Can't say.

Instructions: There is no right or wrong answers. The learners are requested to respond in Yes, No or Can't say.

3.6.0 Procedure of data collection

Data collection defines the procedure for collecting data by the researcher. Primary data is collected to the group of students and the results were analyzed.

The data was collected with the help of research tools. Various ICT pedagogical tools such as videos, multimedia tests quizzes etc act as a treatment presented before the participant students. A pre-test is conducted to obtain their scores through quiz with multiple choice questions was conducted.

Treatment was given for a month and post-test was conducted to obtain their scores.

3.7.0 Statistics for data analysis

The techniques for data analysis were qualitative and quantitative both. The instruments that used were questionnaire with Likert-scale model. The scores of student's learning interest were taken by filling the questionnaire and scores of achievement were taken from the pre-test post-test method.

The population of the study was students of class 9th of a school in Bhopal consisting of 40 students. A 'Purposive Sampling' technique was used to

determine the samples. The study used a survey/questionnaire method and correlation study.

For the purpose of data analysis, the following statistical techniques will be used:

1. To compare mean scores of Achievement in Biology at pre-test and post-test correlated t-test/ Paired sample t-test was used.
2. Questionnaire is used to determine the interest in the subject biology.

2.8.0 Data Analysis

Once data is collected, the next step is to get insights from it to find patterns, connections and relationships. In the present study, the achievement score is calculated by determining the difference between pretest-posttest mean scores. Paired sample t-test is performed to determine the mean scores of the data.

2.8.1 **To compare mean scores** : A **paired-samples (correlated-samples or dependent-samples)** is used when you have one sample of subjects who are tested several times, but under different conditions, that is, under different levels of an independent variable. Each subject is measured on the same dependent variable, but under different levels of an independent variable and you compare performance of the subjects between the different levels of this independent variable (with-subjects design). For the paired *t*-test, we need two variables. One variable defines the pairs for the observations. The second variable is a measurement. Sometimes, we already have the paired differences for the measurement variable. Other times, we have separate variables for “before” and “after” measurements for each pair and need to calculate the differences.

Degree of freedom: Freedom commonly means the total available options or alternatives. People cannot have infinite options. The options will be limited. So, total available options or alternatives are always finite. By adding degree, the freedom should get reduced. The Degree of Freedom can be expressed as:

Degree of Freedom(df)= Total available options/alternatives-Total restrictions imposed

The degree of freedom for the two samples are:

$$df1=40-1=39$$

$$df2= 40-1=39$$

Table 1.

S.No.	Pretest Score of Students(X)	Difference of Mean (X-M)	Mean	Squared Difference of Mean (X-M) ²
1	10	-3.25	13.25	10.56
2	14	0.75		0.56
3	18	4.75		22.56
4	12	-1.25		1.56
5	11	-2.25		5.06
6	10	-3.25		10.56
7	9	-4.25		18.06
8	20	6.75		45.56
9	21	7.75		60.06
10	15	1.75		3.06
11	17	3.75		14.06
12	11	-2.25		5.06
13	12	-1.25		1.56
14	14	0.75		0.56
15	18	4.75		22.56
16	9	-4.25		18.06
17	15	1.75		3.06
18	12	-1.25		1.56
19	14	0.75		0.56

20	13	-0.25		0.06
21	12	-1.25		1.56
22	16	2.75		7.56
23	10	-3.25		10.56
24	20	6.75		45.56
25	13	-0.25		0.06
26	8	-5.25		27.56
27	10	-3.25		10.56
28	13	-0.25		0.06
29	17	3.75		14.06
30	19	5.75		33.06
31	9	-4.25		18.06
32	8	-5.25		27.56
33	14	0.75		0.56
34	16	2.75		7.56
35	11	-2.25		5.06
36	15	1.75		3.06
37	12	-1.25		1.56
38	6	-7.25		52.56
39	11	-2.25		5.06
40	15	1.75		3.06
Total=40	530		13.25	519.50

Pre-test

N_1 : 40

$$df_1 = N - 1 = 40 - 1 = 39$$

M_1 : 13.25

SS_1 : 519.5

$$s^2_1 = SS_1 / (N - 1) = 519.5 / (40 - 1) = 13.32$$

Standard Deviation calculation for Pre-test

Count, N: 40

Sum, Σx : 530

Mean, \bar{x} : 13.25

Variance, s^2 : 13.320512820513

Steps:

$$s = \sqrt{\frac{1}{N-1} \sum_{i=1}^N (x_i - \bar{x})^2},$$

$$s^2 = \frac{\Sigma(x_i - \bar{x})^2}{N-1}$$

$$= \frac{(10 - 13.25)^2 + \dots + (15 - 13.25)^2}{40 - 1}$$

$$= \frac{519.5}{39}$$

$$= 13.320512820513$$

$$s = \sqrt{13.320512820513}$$

$$= 3.64$$

Table 2.

S.No.	Post-test scores of students	Difference of Mean(X-M)	Mean	Squared Difference of Mean(X-M) ²
1	12	-4.23	16.23	17.85
2	16	-0.23		0.05
3	20	3.77		14.25
4	14	-2.23		4.95
5	12	-4.23		17.85
6	12	-4.23		17.85
7	12	-4.23		17.85
8	23	6.77		45.90
9	23	6.77		45.90
10	20	3.77		14.25
11	20	3.77		14.25
12	15	-1.23		1.50
13	15	-1.23		1.50
14	18	1.77		3.15
15	20	3.77		14.25
16	12	-4.23		17.85
17	20	3.77		14.25
18	18	1.77		3.15
19	18	1.77		3.15
20	18	1.77		3.15
21	15	-1.23		1.50
22	20	3.77		14.25
23	12	-4.23		17.85
24	23	6.77		45.90
25	15	-1.23		1.50
26	12	-4.23		17.85
27	12	-4.23		17.85
28	15	-1.23		1.50
29	12	-4.23		17.85
30	15	-1.23		1.50
31	12	-4.23		17.85
32	12	-4.23		17.85
33	15	-1.23		1.50
34	20	3.77		14.25
35	15	-1.23		1.50
36	20	3.77		14.25
37	15	-1.23		1.50
38	18	1.77		3.15

39	15	-1.23		1.50
40	18	1.77		3.15
Total=40	650			486.98

Post-test data analysis

N_2 : 40

$$df_2 = N - 1 = 40 - 1 = 39$$

M_2 : 16.23

SS_2 : 486.98

$$s^2_2 = SS_2 / (N - 1) = 486.98 / (40 - 1) = 12.49$$

Steps to calculate standard deviation

Count, N: 40

Sum, Σx : 650

Mean, \bar{x} : 16.25

Variance, s^2 : 13.576923076923

$$s = \sqrt{\frac{1}{N - 1} \sum_{i=1}^N (x_i - \bar{x})^2},$$

$$s^2 = \frac{\Sigma(x_i - \bar{x})^2}{N - 1}$$

$$= \frac{(12 - 16.25)^2 + \dots + (18 - 16.25)^2}{40 - 1}$$

$$= 529/39$$

$$= 13.576923076923$$

$$s = \sqrt{13.576923076923}$$

$$= 3.68$$

T-value Calculation

$$s_p^2 = ((df_1/(df_1 + df_2)) * s_1^2) + ((df_2/(df_1 + df_2)) * s_2^2) = ((39/78) * 13.32) + ((39/78) * 12.49) = 12.9$$

$$s_{MI}^2 = s_p^2/N_1 = 12.9/40 = 0.32$$

$$s_{M2}^2 = s_p^2/N_2 = 12.9/40 = 0.32$$

$$t = (M_1 - M_2)/\sqrt{(s_{MI}^2 + s_{M2}^2)} = -2.98/\sqrt{0.65} = -3.7$$

The t -value is -3.7038¹. The p -value is .0001.

The result is significant at $p < .05$ and also significant at $p < 0.01$.

Measurement of magnitude of the relationship between ICT as a pedagogical tool and achievement scores of the students by Effect size:

For the independent samples T-test, Cohen's d is determined by calculating the mean difference between your two groups, and then dividing the result by the *pooled* standard deviation.

¹ The t -values are shown as negative but it should always be reported as positive because it represents the difference between means of two groups. Difference is a scalar quantity which has only magnitude but no direction.

$$\text{Cohen's } d = (M_2 - M_1) / SD_{\text{pooled}}$$

where:

$$SD_{\text{pooled}} = \sqrt{((SD_1^2 + SD_2^2) / 2)}$$

Group 1	Group 2
<i>Mean (M): 13.25</i>	<i>Mean (M): 16.23</i>
<i>Standard deviation (s): 3.64</i>	<i>Standard deviation (s): 3.68</i>
<i>Sample size (n): 40</i>	<i>Sample size (n): 40</i>

$$\text{Cohen's } d^2 = (16.23 - 13.75) / 3.66 = 0.6.$$

Data analysis to measure interest :

It is measured with the help of the questionnaire presented to the students after the intervention/treatment. The participants were the same students to whom treatment was given. The survey was conducted with the help of google form. It was filled and submitted by the students and analysed by the reasearcher for the interpretation of the data. The following table illustrates the data representing responses

² **Cohen's D** is one of the most common ways to measure effect size. An effect size is how large an effect of something is.

Small effect = 0.2

Medium Effect = 0.5

Large Effect = 0

Table 3 showing Student's interest in the subject biology taught through ICT Pedagogical tools.

Questions	Total Students	Response - Yes	Response-Yes %	Response-No	Response-No %	Response-Can't Say	Response Can't Say %
1. Learning biology through ICT has been fun for me	40	39	98%	0	0%	1	3%
2. I always look forward to my biology lessons when it is ICT integrated because I enjoy them a lot.	40	39	98%	0	0%	1	3%
3. I am interested in Biology since I was young, but it is difficult to understand some abstract concepts which has become easier through simulations and 3D Video representations	40	35	88%	0	0%	5	13%
4. Learning Biology through ICT also aids in enhancing knowledge and skills in computer technology and how to use them in instructional process in a classroom.	40	34	85%	0	0%	6	15%
5. Using ICT in biology class can positively contribute to the learning	40	33	83%	1	3%	6	15%
6. Using ICT in Biology makes the classroom learning environment effective?	40	35	88%	0	0%	5	13%
7. I find it easier to learn by using ICT	40	37	93%	1	3%	2	5%
8. I think the quality of teaching-learning has improved by integrating ICT in the classroom	40	35	88%	1	3%	4	10%
9. The use of ICT enable us to be more active and engaging in a lesson	40	38	95%	0	0%	2	5%
10. I am looking forward to computer-aided learning in my classroom in future for better understanding of the subject biology	40	39	98%	0	0%	1	3%
Mean		36.4		0.3		3.3	
SD		2.27		0.48		2.11	

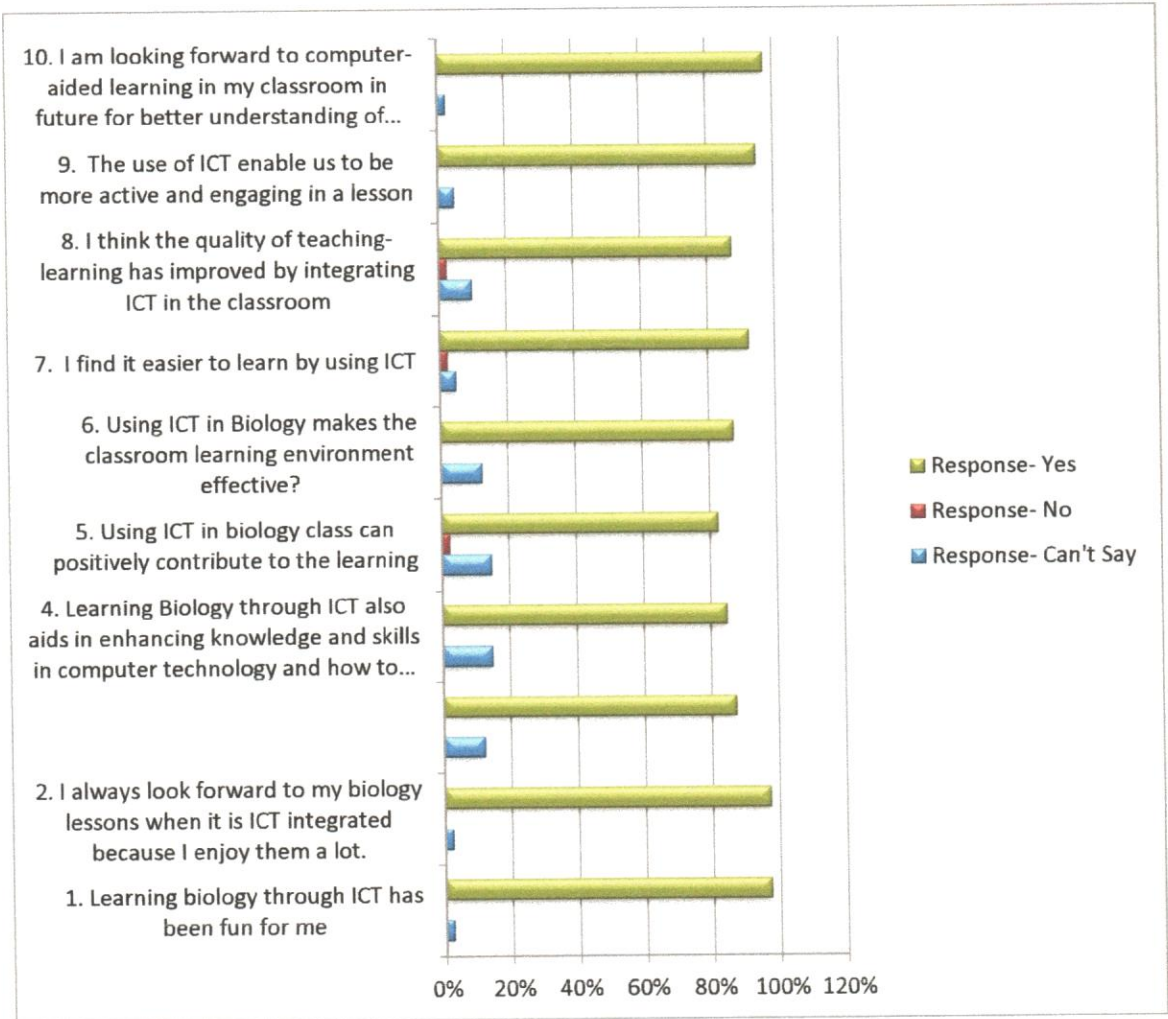


Figure 1 Graphical Representation of the responses given by the students in bar graph.

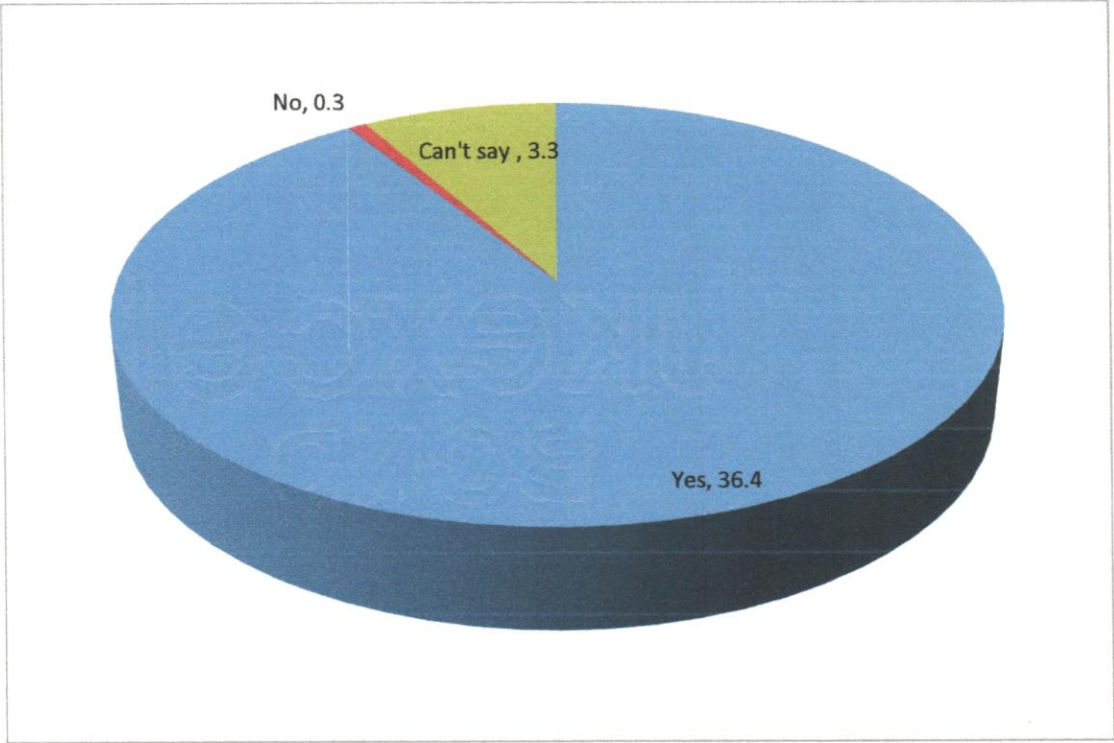


Figure 2 Pie chart showing mean of responses given by the students.