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RESEARCH ARTICLE

A Study on Role of Diagrams in the Evaluation of Learning Outcomes of Secondary Students in Life Science.

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ABSTRACT

In the 20th century, revolutionary changes were brought about in the concepts and theories of biology. Biology, so much important in human life, has been renamed as 'Life Science' in the school curriculum. The age of old chalks and talk method of teaching Life science is getting modified and is being supplemented by new techniques. Learning life science requires not only the linguistic ability of the students but also their ability to understand diagrams in different formats related to the subject, and to translate the diagrams in the verbal form. The students are further required to express their knowledge and understanding in unique way through diagrams. So the theoretical segment of life science is composed of verbal as well as nonverbal diagrammatic representations. Diagrams can facilitate understanding, as information is more visually explicit, requires less inference recognition than sentential representations, and constrains inferences, which can guide cognitive processing. So to find out role of diagram in the evaluation of learning outcome the researcher selected government aided one each girls and boys school from urban and rural area. There he administered diagram based test & achievement test. Then from the raw score he interpreted the data by various statistical tools like mean, standard deviation, correlation and t-test. Thus he found that there is positive correlation between diagram and achievement level in life science. He also found that there is significant difference between mean of scores i.e. t-test score in diagram based and achievement test of secondary boys and girls in the schools of urban vs. rural area.

INTRODUCTION:

The present era is the era of science and technology. There are different branches of the science like Physical science, Life science, Chemical science etc. But among all, Life science is an important subject as it is directly related to the needs of human life.

Life science is changed to a great extent by the development of the Electron–microscopy. Life science knowledge consists not only of a collection of facts, but also more importantly of the way these facts are associated with and interpreted in general theories applied to human life.

In the 20th century, revolutionary changes were brought about in the concepts and theories of biology. Biology, so much important to human life, has been renamed as 'Life Science' in the school curriculum. The age old chalk and talk method of teaching Life science is getting modified and is being supplemented by new techniques. Learning life science requires not only the linguistic ability of the students but also their ability to understand diagrams in different formats related to the subject, and to translate the diagrams in the verbal form. The students are further required to express their knowledge and understanding in unique way through diagrams. So the theoretical segment of life science is composed of verbal as well as nonverbal diagrammatic representations. Teaching, learning and evaluation in Life Science should take this aspect of life science into consideration.

I.2 EMERGENCE OF THE PROBLEM:

Now-a-days, the changes of curriculum, methodology of teaching and learning processes have undergone remarkable changes to cope with the changes of the objectives of Life science teaching and learning. The Life science teaching has begun to shift its focus from teacher centric approach to student centric approach, from knowledge based teaching-learning to understanding based teaching-learning, and from chalk and talk method to discovery learning method. Constructivism in its real sense has dominated the teaching-learning process of Life Science. But a question always arises whether evaluation of learning outcomes in the subject follows the changed pattern of teaching and learning.

Life science curriculum in the secondary level is composed of cognitive and psychomotor domains. **Cognitive domain** consists of concepts, rules, principles, theories and problems. Learning in the cognitive domain essentially requires understanding, analysis, and synthesis and value

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judgement on the part of the students. Diagram plays an important role in the theoretical and practical study of life science. Diagram drawing and analysing require a field perception on the part of the students. To study 'a part' in the background of its 'whole' diagram is very much essential. Diagrams also shares a sizeable part of any text book of Life Science or Biology. Diagram drawing, labelling and using are included in the **psychomotor domain** of learning. But in visual perception of abstract concepts or theories, diagram serves as an essential tool and in that case diagram comes under the purview of 'understanding'. For evaluating the outcomes of learning in Life Science a balance should be there between cognitive and psychomotor practices (in the form of diagrams).

The present practice of evaluation in life science in the secondary stage, laboratory practical is absent. Only written test (along with microscopic weightage on oral tests/ project works) in theory is taken. Tests on the basis of supplied diagrams (called diagrammatic tests) are almost nil. Explicit instructions for drawing and labelling diagram are few and far between. Implicit necessity of drawing diagram in a question is not always readily understood by the students. Its consequences are not at all palatable.

High scorers in achievement tests, sometimes, exhibit weakness in using, drawing and interpretation of diagrams in Life Science. This leaves a serious doubt as to whether the present practices of achievement tests in life science give serious look into the use of diagrams in the evaluation. With this end in view the present researcher is desirous of finding the impact of diagram test on the prevalent achievement test in schools in life science. He would investigate **whether the students maintain their respective ranks in both diagram tests and usual achievement tests in Life Science.** Such investigation might help him to estimate role of diagrams in evaluation in Life Science. With this end in view the present researcher has selected a topic for his dissertation-***"A Study on the Role of Diagrams in the Evaluation of Learning Outcomes of Secondary Students in Life Science"***

I.3. STATEMENT OF THE PROBLEM:

The problem opted by the researcher may be stated as – ***A Study on the Role of Diagrams in the Evaluation of Learning Outcomes of Secondary Students in Life Science.***

I.4. OPERATIONAL DEFINITION OF SOME IMPORTANT TERMS USED:

- **Cognition: -** A term indicates knowledge & awareness which includes perceiving, remembering, reasoning & other means of knowing about oneself & the environments.
- **Life Science: -** (Encyclopedia of science) Life science is a branch of natural science that comprises of the fields of science (i.e. Botany, zoology, and Physiology etc.) and involves in dealing with the structure, characteristics and behaviors of living organism like plants, animal and micro-organism.
- **Diagram: -** A diagram is a two dimensional geometric symbolic representation of information according to some visualization technique. In science according to Anderson [1997] Diagrams are pictorial, yet abstract, representation of information and maps, line graphs, bar charts, engineering blueprints & architects sketches are all examples of diagrams.
- **Learning outcomes: -** The **UNESCO** definition identifies students **learning outcomes** as Statements of what a learner is expected to know, understand, and/or be able to demonstrate after completion of a process of learning as well as the specific intellectual and practical skills gained and demonstrated by the successful completion of a unit, course, or program. Learning outcomes, together with assessment criteria, specify the minimum requirements for the award of credit, while grading is based on attainment above or below the minimum requirements for the award of credit. Learning outcomes are distinct from the aims of learning in that they are concerned with the achievements of the learner rather than with the overall intentions of the teacher. (Vlăsceanu *et al*., 2004, pp. 41–42)
- **Diagram Test:** A diagram is a 2D geometric symbolic representation of information according to some visualization technique. Sometimes, the technique uses a 3D visualization which is then projected onto the 2D surface. In science the term is used in both ways. For example Anderson (1997) stated more generally: "diagrams are pictorial, yet abstract, representations of information, and maps, line graphs, bar charts, engineering blueprints, and architects' sketches are all examples of diagrams, whereas photographs and video are not".

- Diagram types: There are at least the following types of diagrams:
- Graph-based diagrams: these take a collection of items and relationships between them, and express them by giving each item a 2D position, examples of such techniques: tree diagram, network diagram , flowchart, Venn diagram , existential graph
- Chart-like diagram techniques, which display a relationship between two variables that take either, discrete or continuous ranges of values; examples: histogram, pie chart, bar chart, functional graph, scatter plot. Other types of diagrams, e.g., train diagram, exploded

view, population density map, pioneer plaque, Three-dimensional diagram.

I.5. OBJECTIVES OF THE STUDY:

- 1. To prepare a diagram based test in life science for class VII standard under WBBSE syllabus.
- 2. To prepare an achievement test in life science for class VII standard under WBBSE syllabus.
- 3. To administer the achievement and diagram based test in Life Science on class VIII students.
- 4. To find the mean, standard deviation, and other descriptive statistics such as coefficient of correlation on the basis of raw score.
- 5. To find the mean and standard deviation of the scores of the two tests sex-wise and strata-wise.
- 6. To find the correlation between diagrams based test and achievement test score.
- 7. To represent the scores graphically.
- 8. To find the significance of the difference of the mean scores in achievement test obtained by high and low scorer in diagram tests in life science.

I.6. SIGNIFICANCE OF THE PROBLEM:

- Importance of drawing & labelling in learning life science.
- Importance on improvement of psychomotor domain side by side to cognitive domain.
- Changing the teaching skill accordingly to the importance of drawing & labelling in life science.
- Learners get skilled in drawing at least to the basic level.
- Learners not only learned the verbal knowledge but also the nonverbal knowledge.

I.7. DELIMITATION OF THE STUDY:

In order to conduct the study the researcher had delimited the planning of the investigation qualitatively and quantitatively, i.e. in terms of the research and to the sample to be studied in the following way:

1. Variables:- The researcher employed two variables

- Diagram based test in life science.
- Achievement test in life science.

2. Tools: - The researcher uses the following psychological test for measuring the achievement and learning outcomes of the students.

- Diagram based test in life science.
- Achievement test in life science.

3. Sample:-Because of very short time, the researcher will take a sample of 200 students from 2 schools (1 Boys, 1Girls) of rural and 2 schools (1Boys, 1Girls) of urban area.

4. Subject area of the study: - The content area for the role of diagram in the evaluation of learning outcome will be selected from the each & every unit from the syllabus of VII standard of Life science approved by WBBSE.

5. Nature of the school: - Only Bengali medium schools will be selected which are recognised by WBBSE.

6. Location of the school: - Only two Secondary schools (1Boys&1Girls) located in the district of Hooghly as an urban and two schools (1Boys&1Girls) located in the rural area of the district Hooghly will be selected for the study.

7. Techniques of analysis:-

(1) Use of descriptive Statistics-Mean, Standard Deviation (SD) (2) Inferential Statistics–Coefficient of correlation, t-test, O-give test.

I.8. HYPOTHESIS OF THE RESEARCH:

1. There is no significant difference between secondary boys and secondary girls in respect of their achievement level towards life science.

2. There is no significant difference between secondary students of rural and urban area in respect of their achievement level towards life science.

3. There is no significant difference between secondary boys and girls of urban area in respect of their achievement level towards life science.

4. There is no significant difference between secondary boys and girls of rural area in respect of their achievement level towards life science.

5. There is no significant difference between secondary boys of rural and urban area in respect of their achievement level towards life science.

6. There is no significant difference between secondary girls of rural and urban area in respect of their achievement level towards life science.

7. There is no significant correlation between score of diagram based test and achievement test in life science in case of secondary students.

8. There is no significant difference between secondary boys and secondary girls in respect of their score of diagram test in life science.

9. There is no significant difference between secondary students of rural and urban area in respect of their score of diagram test in life science.

10. There is no significant difference between secondary boys and girls of urban area in respect of their score of diagram test in life science.

11. There is no significant difference between secondary boys and girls of rural area in respect of their score of diagram test in life science.

12. There is no significant difference between secondary boys of rural and urban area in respect of their score of diagram test in life science.

13. There is no significant difference between secondary girls of rural and urban area in respect of their score of diagram test in life science.

REVIEW OF RELATED LITERATURE:

The significant study done by different researchers are as follows:-

II.1. STUDIES ON CONCEPT IN INDIA:

- **Kumari Meena Shasikala G (1991)** found out that the difference in the total number & level, knowledge, comprehension, application of question asked by male and female students, to find out the difference in the number & level question asked by students from different level of achievement, and to ascertain the joint effects of sex & achievement , sex & teacher competency , sex & extraversion on the number & level of question asked by students ; it was observed that intelligence ,achievement in biology & extraversion had a significant effect on the number and level of question asked by the students, sex had significant role on the level of question asked, boys who were high on intelligence & extraversion asked significantly more higher level questions than girls.
- **Vaidya N (1991)** found out that to develop teaching learning strategies for the enhancement of achievement in science & to examine Piaget type tasks could be attempted to the students if there is an acceleration of their thought & to determine the effectiveness of 4 different methods of teaching high school students how to reason with diagrams in biology text books.
- **Mehta, A.D.(1990)** found out that to identify sex role in preschool children from different socioeconomic classes, it was found out that there was a positive relation of performance on Draw –A- Man Test & vocabulary test for girls, this relationship is not significant in case of boys
- **Maehr (1989)** found out that to find out if there was any relation of drawing and literacy connection it was found out that, young children may consider their drawing to be actual writing.
-

II.2. STUDIES ON THE CONCEPT ABROAD:

- **Sharon Dominica (2011)** found out that to get ideas to increase drawing with preschooler it was found out that drawing is an important part of literacy development 7 it becomes a method of visual thinking & communication, as children explain their drawing they develop vocabulary and verbal skills.
- **Dr. B. Kollöffel (2008)** found out that to find out how drawing summaries in science education it was found out that a possible means for building conceptual, operational, situational knowledge is letting learners create drawings that represent their knowledge about a certain domain & it constrains learners understanding.
- **David F. Lohman (2005)** found out that to assess students' abilities in reasoning & problem solving using Verbal Quantitative, Nonverbal symbols it was find out that the Cog AT measures student's learned reasoning abilities in the three areas most linked to academic success in schools: verbal, Quantitative, Nonverbal.
- **Dougal MacDonald (2004)** found out that how much a teacher intervene in order to enhance and broaden children's authentic use of drawing in life science and role of it in communicating ideas & underemphasizes its role in creating and developing ideas.
- **Haydee M Cuevas *et* al (2002)** found out that Diagrams additionally facilitated the development of accurate mental models (as measured via a card sorting task) and significantly improved the instructional efficiency of the training (i.e., higher level of performance was achieved with less mental effort). Finally, diagrams effectively scaffold participants' metacognition, improving their metacomprehension accuracy (i.e., their ability to accurately monitor their comprehension). These beneficial effects of diagrams on learners' cognitive and metacognitive processes were found to be strongest for participants with low verbal ability.
- **Sylvia Chard (1999)** found out that if there was any relation of drawing and literacy connection it was found out that, when children doing observational drawing children look closely & observed carefully & drawing also helps them remember past experience.
- **Chappel PA (1993)** found out that the age-stage relationship between young children's human figure drawings and Piaget's levels of cognitive development, which was investigated using 45 young children ages 4 through 6 years, the analysis indicated a distinct monotonic trend between cognitive stage and drawing level; as cognitive ability increased so did drawing level. This suggests that children's human figure drawings can be a simple tool for the quick assessment of cognitive levels in young children.
- **Thomas *et al* (1978)** found out that whether the readability of text could be improved by adding pictorial illustration & diagrams.
-

II.3. SUMMARY OF THE LITERATURE REVIEW:

So it can be concluded after literature review that Diagrams can facilitate understanding, as information is

more visually explicit, requires less inference recognition than sentential representations, and constrains inferences, which can guide cognitive processing. A major area of research in science education over the world is cognitive studies. There are about 32% area where cognitive studies done in science. Cognitive research aims at developing "a science of science learning". Much research into the use of diagrams has provided evidence for the benefits of such external representations. A diagram can support cognitive processing generally, by acting as an 'external aid to thought' (Addis 1997), but has also been found to ease processing or reasoning and problem solving. Investigation into the literature on diagrams has revealed limited current knowledge of the cognitive value of drawing and labeling in life science subject especially in case of secondary curriculum. So, the researcher chooses this topic and wants to know the Role of Diagrams in the Evaluation of Learning Outcomes of Secondary Students in Life Science.

METHODOLOGY OF RESEARCH:

III.1. **Population:**

Secondary school students of Bengali medium under WBBSE board of urban and rural area in Hooghly district studying in class VIII of the academic session 2011-'12, constitute the entire population of the study.

III.2. **Sample:**

The researcher selected 4 high schools under WBBSE board from rural and urban area of Hooghly district. Out of 4 schools one is Government and other three are Government aided schools. From rural and urban area one each boys and girls schools are selected.

Sr. No.	Name of the schools	Board	Boys/ Girls	Rural/Urban
1.	Uttarpara Gov. High School	WBBSE	Boys	Urban
2.	Uttarpara Girls High Schools	WBBSE	Girls	Urban
3.	Babnan High school [H.S.]	WBBSE	Boys	Rural
4.	Babnan High school [H.S.]	WBBSE	Girls	Rural

Table 1: W.B.B.S.E.:- West Bengal Board of Secondary Education

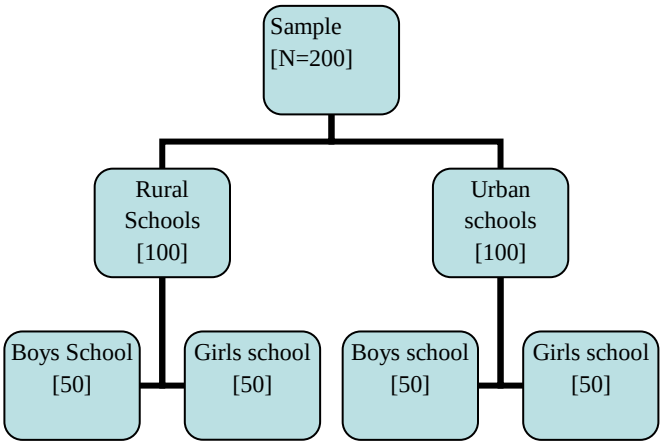


Figure 1: The sampling frame was as follows

III.3. **Sampling Technique**

The cluster sampling technique using convenient method was followed.

III.4. **Sources of Data**

i. Scores obtained by the students in Achievement test in life science was prepared and administered by the investigator.

ii. Scores obtained by the students in Diagram based test in life science was prepared and administered by the investigator.

The test items in Achievement Test covers entire life science syllabus of Class VII and administered the test to the students of class VIII, under WBBSE board.

III.5. **Tools and Techniques of data collection**

A. Tools:

a. An achievement test in life science was prepared by the investigator. The test consisted of four questions carrying three marks and four questions carrying 2 marks each. The full marks of the test were 20.

b. A Diagram based test in life science was prepared by the investigator. The test consisted of three questions carrying 5, 3, 2 marks respectively. The full marks of the test were 10.

c. Both the tests were validated by the project guide Dr. Kamal Krishna De.

B. Statistical Techniques:

a. Determination of mean and standard deviation.

b. Determination of Co-relation coefficient.

c. Determination of t-ratio.

d. Make O – Give test.

III.6. Design for Construction of Achievement & Diagran based Test

Subject- Life Science

Board- W.B.B.S.E.

Class- VII

Specificaton of Instructional Objectives

1) Knowledge:

The learners will be able to –

i) Recall the different organs of male and female reproductive system.
ii) Recall the scientific name of medicinal plant.
iii) Define the royal jelly of honey bee.

2) Understanding:

The learners will be able to –
i) Differentiate artery and vein.
ii) Recall the cause behind calling honey bee as social insect.

3) Application:

The learners will be able to –
i) Recall different parts of a complete flower.
ii) Trace the role of gynoecia in a complete flower.

4) Skill:

The learners will be able to –
i) Recall the identifying characters of gymnosperms.
ii) Draw the labeled diagram of heart of a toad.
iii) Label the different parts of a complete flower and distinguish the identifying characters of complete & incomplete flower.

A) **Weightage to Instructional objectives:**

Instructional objectives	Marks allotted	Weightage (%)
Knowledge	7	23
Understanding	5	17
Application	8	26
Skill	10	34
Total	30	100

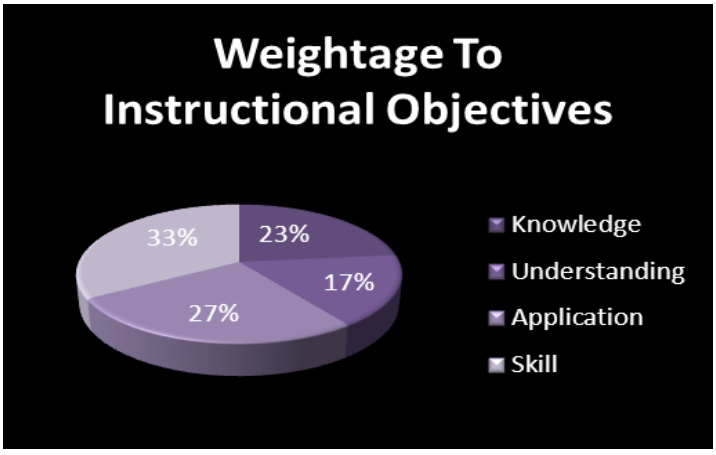


Figure 2: Representation through 3D-Pie Diagram

B) **Weightage to Content:-**

Content	Marks Allotted	Weightage [%]
Reproductive Structures of Plants	10	34
Organ and Systems of Animal	11	36
General Idea and Importance of the following Plants and Animals	6	20
Concepts of Characteristic Features of Plants and Animal groups	3	10
Total	30	100

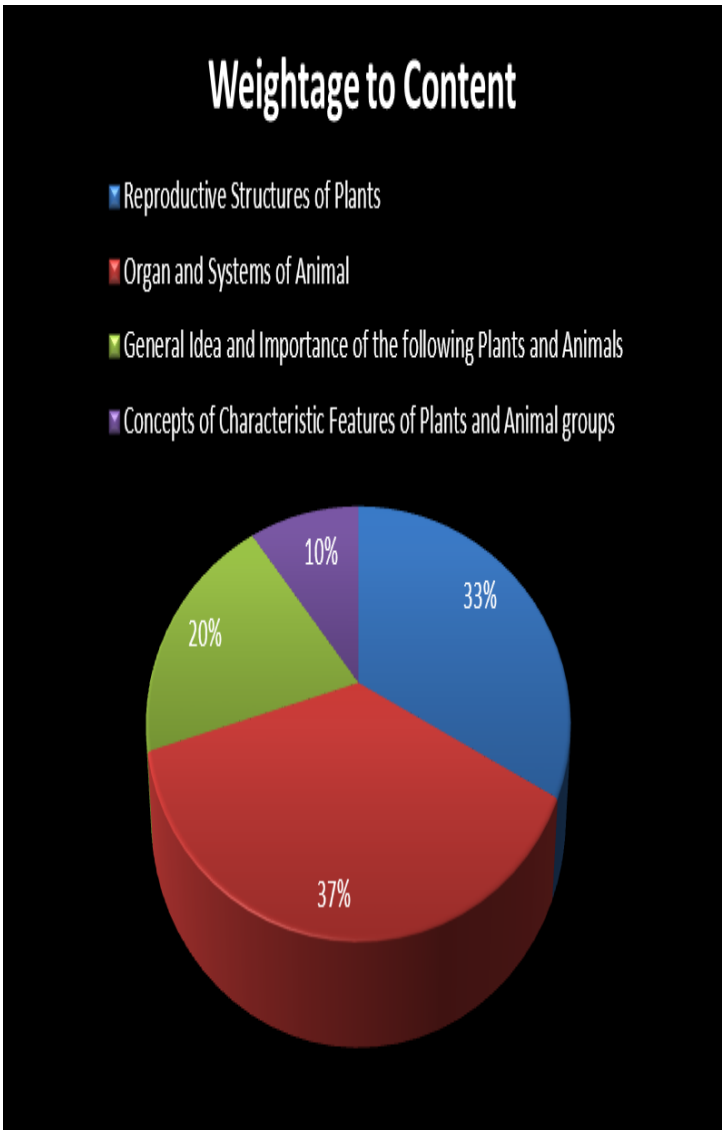


Figure 3: Weightage to Content

Presentation and 0f Data:

IV.1. School category-wise mean and SD in achievement and diagram based test

Table: IV.12.

Presentation of school category wise mean and standard deviation in Achievement & Diagram based test.

Schools' categories	Achievement Test		Diagram Based Test	
	Mean	S.D.	Mean	S.D.
1.Uttarpara Govt. High School[Urban Boys School]	10.52	3.855766695	6	2.258769757
2.Uttarpara Girls High School[Urban Girls School]	11.06	4.55985141	6.2	2.089819834
3.Babnan High School[H.S.][Rural Boys School]	6.08	1.322335596	4.68	0.586932531
4.Babnan High School[H.S.][Rural Girls School]	6.5	2.05038572	4.5	0.931314629

IV.2. Sex wise Mean and S.D. in Achievement, Diagram test

Table: IV.13.

Sex wise category	Achievement Test		Diagram Based Test	
	Mean	S.D.	Mean	S.D.
Girls	8.78	4.083918	5.35	1.822281
Boys	8.31	3.628437	5.34	1.770807

IV.3. Area wise Mean and S.D. in Achievement, Diagram test

Table: IV.13.

Area wise category	Achievement Test		Diagram Based Test	
	Mean	S.D.	Mean	S.D.
Rural	6.29	1.430512	4.59	0.779731
Urban	10.8	4.199567	6.1	2.167249

IV.4. Determination of the Significance of difference between two means: In this research study the sample size was large (i.e. more than 30 in number) and the sample was drawn at random from the totally different and unrelated groups. So this is the case of large but independent samples.

So, in this case, the value for the difference in sample means can be computed with the help of **'t - test'**.

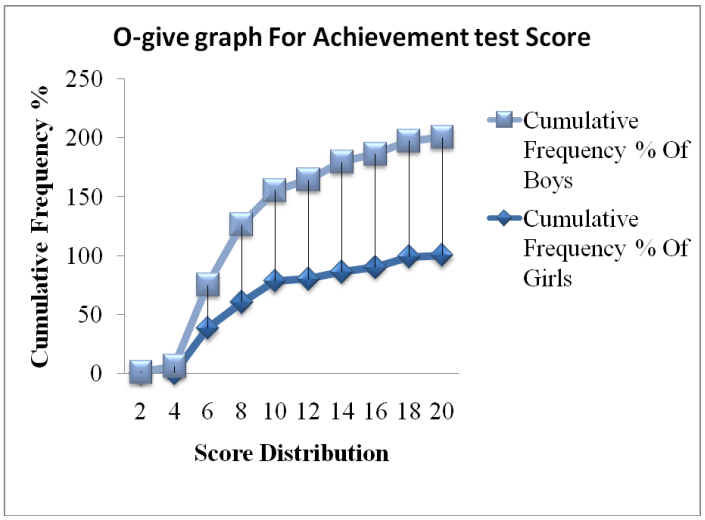
Table: IV.13. With degree of freedom df = (n – 2) = (100 – 2) = 98, the table value of t at 0.05 = 1.99, and at 0.01 = 2.63.

	Diagram **(t)**	Achievement **(t)**
Boys vs. Girls	0.039389315(NS)	0.732457015(NS)
Rural vs. Urban	6.548342184 (S at 0.01 level)	10.12092399 (S at 0.01 level)
Urban Boys vs. Urban Girls	0.459419417(NS)	0.639125314 (NS)
Rural Boys vs. Rural Girls	1.155652082(NS)	1.218041304 (NS)
Urban vs. Rural boys	3.0996075572 (S at 0.01 level)	7.696002736 (S at 0.01 level)
Urban vs. Rural Girls	5.254828615 (S at 0.01 level)	6.449316911 (S at 0.01 level)

IV.5. Grouping of raw score into frequency distribution:

- **Sex wise category: Original score obtained by 200 students of boys and girls students of rural and urban schools for their achievement test score.**

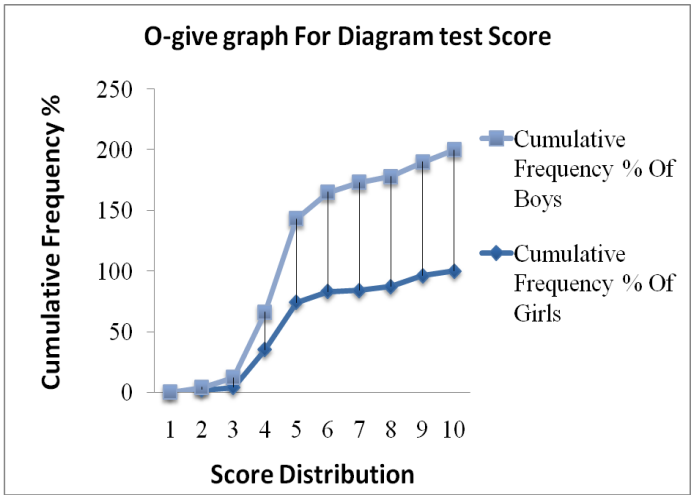
Score Distribution	c.f. % of girls	c.f. % of boys
2	0	1
4	0	6
6	38	37
8	60	66
10	78	77
12	80	84
14	86	93
16	90	96
18	99	98
20	100	100



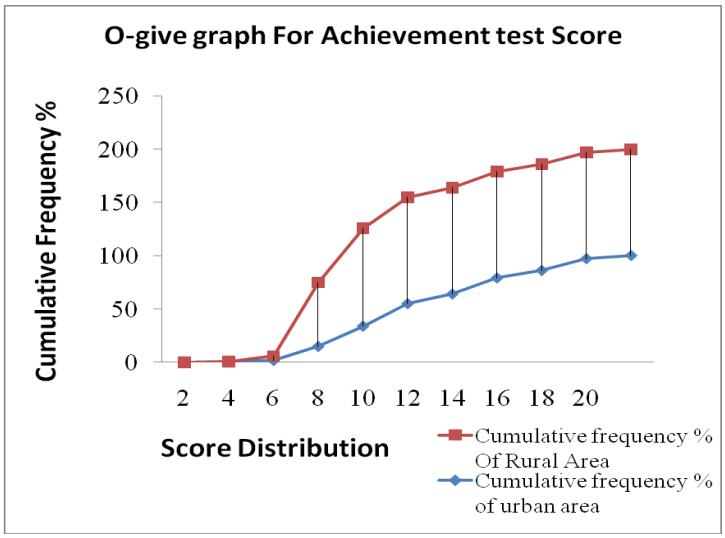
Score Distribution	c.f. % of urban area	c.f. % of rural area
2	1	0
4	2	4
6	15	60
8	34	92
10	55	100
12	64	100
14	79	100
16	86	100
18	97	100
20	100	100

- **Original score obtained by 200 students of boys and girls students of rural and urban schools for their diagram test score.**

Score Distribution	c.f. % of girls	c.f. % of boys
1	0	0
2	2	2
3	4	8
4	35	31
5	74	69
6	83	82
7	84	89
8	87	91
9	96	94
10	100	100

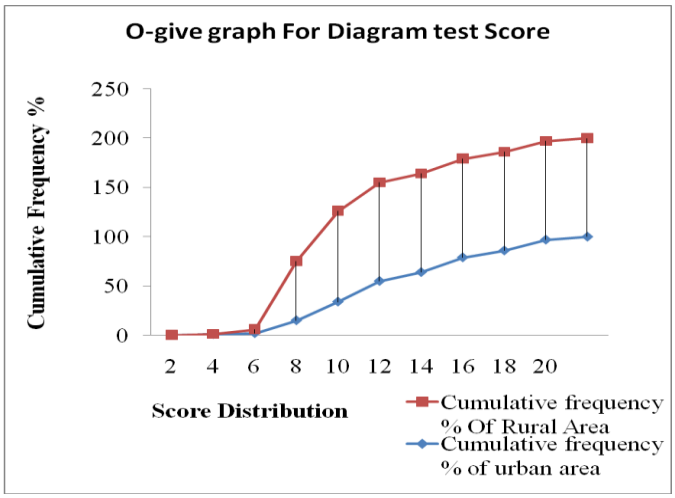


- **Area wise category: Original score obtained by 200 students of rural and urban area for their Achievement test score.**



Original score obtained by 200 students of rural and urban area for their Diagram test score.

Score Distribution	c.f. % of urban area	c.f. % of rural area
1	0	0
2	2	2
3	7	5
4	23	43
5	52	91
6	65	100
7	73	100
8	78	100
9	90	100
10	100	100



IV.6. Correlation between diagram based and achievement test.

Sr. No.	diagram based test:-10	achievement test20
1	10	18
2	5	9
3	5	7
4	6	10
5	5	10
6	4	7
7	5	9
8	10	18
9	9	16
10	4	7
11	5	6
12	8	9
13	6	10
14	7	13
15	6	14
16	6	11
17	5	7
18	3	10
19	10	9
20	4	13
21	5	5
22	5	8
23	5	4
24	5	5
25	5	5
26	5	8
27	5	7
28	4	8
29	5	6
30	5	4
31	5	5
32	6	7
33	5	6
34	4	5
35	5	9
36	4	6
37	4	5
38	4	5
39	5	6
40	4	6
	Coefficient of correlation	r = 0.678943713

Comment:

- With degree of freedom 38, the table value of 'r' at 0.05 level = 0.325 and at 0.01 level = 0.418.
- The calculated value of 'r' = 0.678943713.
- This calculated 'r' value is much higher than table value 0.325 & 0.418 i.e. at 0.05 & 0.01 levels respectively.
- Therefore the calculated value of r, i.e. 0.678943713 is highly significant at both 5% and 1% level.
- **So null hypothesis number (7) is rejected.**

FINDINGS AND CONCLUSION AND SUMMARY:

V.1.:- Findings:

1. The computed value of 't' in case of all boys vs. girls of rural and urban areas for diagram skill, achievement test scores are 0.039389315, 0.732457015 respectively. Therefore the difference between mean of those test scores for all boys vs. girls is not statistically significant. **Hence the null hypothesis number 1 is retained.**

2. The computed value of 't' in case of all boys and girls of rural vs. urban areas for diagram skill, achievement test scores are 6.548342184, 10.12092399 respectively. Therefore the difference between mean of those test scores for all boys vs. girls is highly significant. **Hence the null hypothesis number 2 is rejected.**

3. The computed value of 't' in case of urban boys vs. urban girls for diagram skill, achievement test scores are 0.459419417, 0.639125314 respectively. Therefore the difference between mean of those test scores for urban boys school and urban girls school is not statistically significant. **Hence the null hypothesis number 3 is retained.**

4. The computed value of 't' in case of rural boys and rural girls for diagram skill, achievement test scores are 1.155652082, 1.218041304 respectively. Therefore the difference between mean of those test score for rural boys and girls school is not statistically significant. **Hence the null hypothesis number 4 is retained.**

5. The computed value of't' in case of urban boys and rural boys for diagram skill, achievement test scores 3.0996075572, 7.696002736 are respectively. Therefore the difference between mean of those test score for urban boys and rural boys school is highly significant. **Hence the null hypothesis number 5 is rejected.**

6. The computed value of't' in case of urban girls and rural girls for diagram skill, achievement test scores are 5.254828615 6.449316911 respectively. Therefore the difference between mean of those test score for urban and rural girls school is highly statistically significant. **Hence the null hypothesis number 6 is rejected.**

7. With degree of freedom 38, the table value of 'r' at 0.05 level = 0.325 and at 0.01 level = 0.418. The calculated value of 'r' = 0.678943713. This calculated 'r' value is much higher than table value 0.325 & 0.418 i.e. at 0.05 & 0.01 levels respectively. Therefore the calculated value of r, i.e. 0.678943713 is highly significant at both 5% and 1% level. **So null hypothesis number 7 is rejected.**

V.2.:- CONCLUSION:

1. **In life science the correlation between scores of diagram test and achievement tests is significantly high.** So there is a significant positive correlation between scores of diagram based test and achievement test in life science in case of secondary students. So it can be concluded that there is a definite role of diagram skill in the learning outcomes of Secondary Students of W.B.B.S.E. in Life Science.

2. There is significant difference between t-test score in diagram based and achievement test of secondary boys and girls in the schools of urban vs. rural area.

3. There is significant difference between t-test score in diagram based and achievement test of urban vs. rural boys.

4. There is significant difference between t-test score in diagram based and achievement test of urban vs. rural girls.

5. There is no significant difference between t-test score in diagram based and achievement test of boys vs. girls of rural and urban areas.

6. There is no significant difference between t-test score in diagram based and achievement test of urban boys vs. urban girls.

7. There is no significant difference between t-test score in diagram based and achievement test of rural boys vs. rural girls.

V.3.:- Limitation of the study:

There were certain limitations that might have reduced the space of generalization and accuracy of the study. These are as follows:-

- The full marks of achievement test & diagram based test were only 20 & 10 respectively [because the school authorities had some difficulties to allow more than 40 minute i.e. a period for the administration of the tests.]
- The investigator does not get sufficient time to prepare this study.
- The sample size is small i.e. only 200.
- Only the syllabus of WBBSE was chosen by the investigator.
- Only the curriculum of class VII was chosen to make the tests and the tests were administered to class VIII students only.
- Government aided only one girl and boys Bengali medium schools each of rural and urban area were chosen to administer the test.

For the statistical analysis only mean, standard deviation, O-give, t- test, and linear correlation were applied. The investigator did not use ANOVA or regression analysis in this study.

V.4.:- EDUCATIONAL IMPLICATIONS:

The study has wide educational implications. First of all the present study indicates the significant effect of diagram skill in achievement level of students can be observed in case of life science education.

The following are the areas where the findings of above study can be used or taken care of.-

- **Text Book:** Text books are to be written in such a way so that adequate emphasis must be given on diagram skills. Significant illustrations should be made at every opportune place.
- **Teaching & Learning:** At the time of teaching teacher should be careful so that diagram skills are practiced and emphasised.
- **Teacher Education:** In the teacher education curriculum such diagram skills are to be exercised so that they would be teachers become properly trained where and how the diagram skills are to be developed and used properly.

V.5.:- Summary:

In the 20th century, revolutionary changes were brought about in the concepts and theories of biology. Biology, so much important in human life, has been renamed as 'Life Science' in the school curriculum. The age of old chalks and talk method of teaching Life science is getting modified and is being supplemented by new techniques. Learning life science requires not only the linguistic ability of the students but also their ability to understand diagrams in different formats related to the subject, and to translate the diagrams in the verbal form. The students are further required to express their

knowledge and understanding in unique way through diagrams. So the theoretical segment of life science is composed of verbal as well as nonverbal diagrammatic representations. Diagrams can facilitate understanding, as information is more visually explicit, requires less inference recognition than sentential representations, and constrains inferences, which can guide cognitive processing. So to find out role of diagram in the evaluation of learning outcome the researcher selected government aided one each girls and boys school from urban and rural area. There he administered diagram based test & achievement test. Then from the raw score he interpreted the data by various statistical tools like mean, standard deviation, correlation and t-test. Thus he found that there is **positive correlation between diagram and achievement level in life science.** He also found that there is **significant difference between mean of scores i.e. t-test score in diagram based and achievement test of secondary boys and girls in the schools of urban vs. rural area.**

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