

EVIDENCE BASED LEARNING: AN ANALYSIS OF IMPACT OF TEACHER'S DESIGN MODEL ON CONCEPTUAL UNDERSTANDING



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ABSTRACT

Lewis dot structure is taught in Chemistry at senior secondary school level. The competence to draw the Lewis dot structure and its interpretation lays foundation for advance learning. In the present paper attempt is made to investigate the impact of teacher made model to enhance deep conceptual understanding of Lewis dot structure in Chemistry. The concept is taught by using expository and discussion method but these teaching methods do not improve the students' ability to construct their knowledge - as a result learners do not have deep conceptual understanding. An optional way to increase learner's understanding in cognitive aspect is by using teaching aids developed by the teacher. Feasibility percentage of these models is 95%. The present research uses one group (pre-formative and post formative assessment) experimental design. Totally 35 students of Grade 12 partake in the study. Purposive sampling technique is used to draw the sample. Data is collected by using formative assessment before and after the treatment. Test score and t-test are the statistical tools used for the analysis of data. The content test validity is 96% and the reliability co-efficient is 0.86 on Spearman-Brown. Result of the present study illustrates that the model developed for teaching-learning of Lewis dot structure is effective to enhance the deep conceptual learning and to acquire intended learning outcomes. It is illustrated by the paired analysis of sample t with t score (-38.52) is less than the critical - t value (-2.03). There is a major difference in the scores of learners before and after the treatment. The effectiveness of teacher made Lewis dot structure model is determined by formative assessment both before and after the treatment. The score of cognitive skills (0.658) is categorized under moderate gain.

1. INTRODUCTION

“Always remember life is a learning journey. Keep filling your mind with all that is worthy”

- Catherine

In Chemistry, Lewis dot structure represents two dimensional model of molecules that shows the Valence of electrons (i.e) non-bonding and bonding electrons. Valence electrons are the outer shell electrons that are involved in the power of combination of electrons. Q.N. Lewis introduces a simple notation which represents the valence

electron in atoms. These notations are called symbols or electron dot symbols. In a chemical bond pair of electrons spin in the opposite direction and are magnetize to the atomic nuclei that they connect with. Individual atoms in the bond try to mimic and attain noble gas electronic configuration that contains 8 electrons (an octave). The learning outcome of Chemistry is the deep understanding of structure and their interactions between the individual molecules that affects the observable microscopic behaviour of the substance. The relation between the structure and the physical and the chemical characteristic is the central dogma of Chemistry.

When teaching-learning Chemistry at Senior Secondary school most of the structures involves Lewis dot structure and hence acquiring mastery over the Lewis structure is vital and it helps to predict the physical properties such as acidity, basicity, resonance molecular geometry, structural isomerism and reactivity.

Lewis dot structure is not explicitly listed in our school curriculum and hence classroom instruction are not paid due attention normally. The specific learning objectives of Lewis structure are as under:

- 1) To write full and noble gas configuration and to find the position of an element in the long form of periodic table.
- 2) To apply periodic table to predict the relative properties of an element based on their pattern.
- 3) To construct and compare covalent and ionic compound form.
- 4) To construct model and tools.

Students must be able to construct the model on the basis of the illustration of ideas and explanation. Models are fabricated to design questions, predict, explain, critically analyze and to diagnose the flaws in the system, build and revise. Scientific explanation, observation and measurements are used and reused to improve, revise and re-design the model. Model includes drawing, diagrams, physical replica, mathematical representation, analogies and technology.

As a chemistry teacher I strongly believe that Lewis structure should be taught in Chemistry at Senior Secondary level for deep conceptual understanding, to draw and interpret the structure and to lay a strong foundation for advance learning. Lewis dot structure is taught in Grade 11 but while teaching 'p block element' in Grade 12 especially when teaching Oxides of Nitrogen most of the students struggle to draw the structure. Drawing Lewis dot structure is more challenging in the circumstances such as:

- 1) Increased model complexities (N_2O_4 , N_2O_5)
- 2) Giving the formula with no clue of structure (HNO_3)

Learners get frustrated and demotivated at times when they are not able to find the correct attachment of atoms. Most of the students in Grade 12 are able to draw the Lewis structure that has single bond and obey the octet rule. The conceptual understanding of Chemistry takes place at three levels:

- 1) Microscopic - oxygen from air we breathe
- 2) Particulate and sub microscopic - two identical attracts
- 3) Symbolic and representative level - O_2

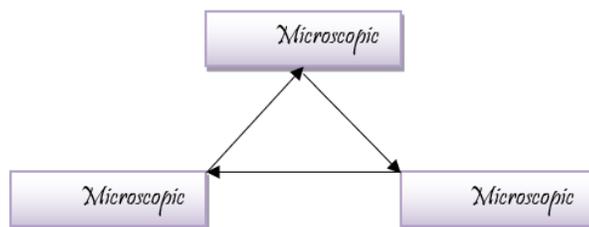


Fig 1: Johnson's Triangle

2. METHODS

2.1. RESEARCH DESIGN

Experimental research design with one group is used. Formative assessment is conducted before and after the treatment.

Table 1: Research Design

<i>Pre-test</i>	<i>Treatment</i>	<i>Post-test</i>
<i>O₁</i>	<i>X₁</i>	<i>O₂</i>

Where

- O₁ → Formative assessment before treatment
- O₂ → Formative assessment after treatment
- X₁ → Using of Lewis dot structure model

2.2. SAMPLE

Purposive sampling technique is used to draw the sample. Totally 35 students of Grade 12 participate in the study.

2.3. TOOL

To gather the data formative assessment (cognitive assessment) tool is used. The content validity of the instrument is 96%. Totally 30 questions are found to be valid. The reliability coefficient score based on Spearman Brown test is found to be 0.86. The 't' score is high when it is

2.4. ANALYSIS OF DATA

Descriptive analysis technique is used to analyze the data collected. Data obtained from the formative assessment before the treatment and after the treatment is analyzed and paired with sample t-test. The Lewis dot structure teaching tool made by the teacher is proved effective as there are some variances in the score obtained through formative assessment before the treatment and after the treatment. The gained score is formulated as given below:

$$\text{Improved Score } (x) = \frac{\text{FAA} - \text{FAB}}{\text{Total} - \text{FAB}}$$

Improved score is classified under three criteria:

Table 2: Improved score criteria

Improved Score Scale	Criteria
X > 0.70	High
0.30 ≤ X < 0.70	Moderate
X < 0.30	Low

2.5. PROCEDURE

The research procedures to investigate the effectiveness of the Lewis dot structure teaching model on achieving the learners' cognitive specific learning outcomes are as follows:

- 1) Design the Lewis dot structure model and research tools
- 2) To know about the feasibility of the model – validity test is conducted.
- 3) Trial of the Lewis dot structure model and the test tool is carried out on small sample scale.
- 4) The trial is conducted in a specific class setting.

- 5) Investigation on the achievement of student's cognitive specific learning outcome is done to find out the effectiveness of Lewis dot structure model so as to enhance student's cognitive specific learning outcomes.

2.6. HYPOTHESIS

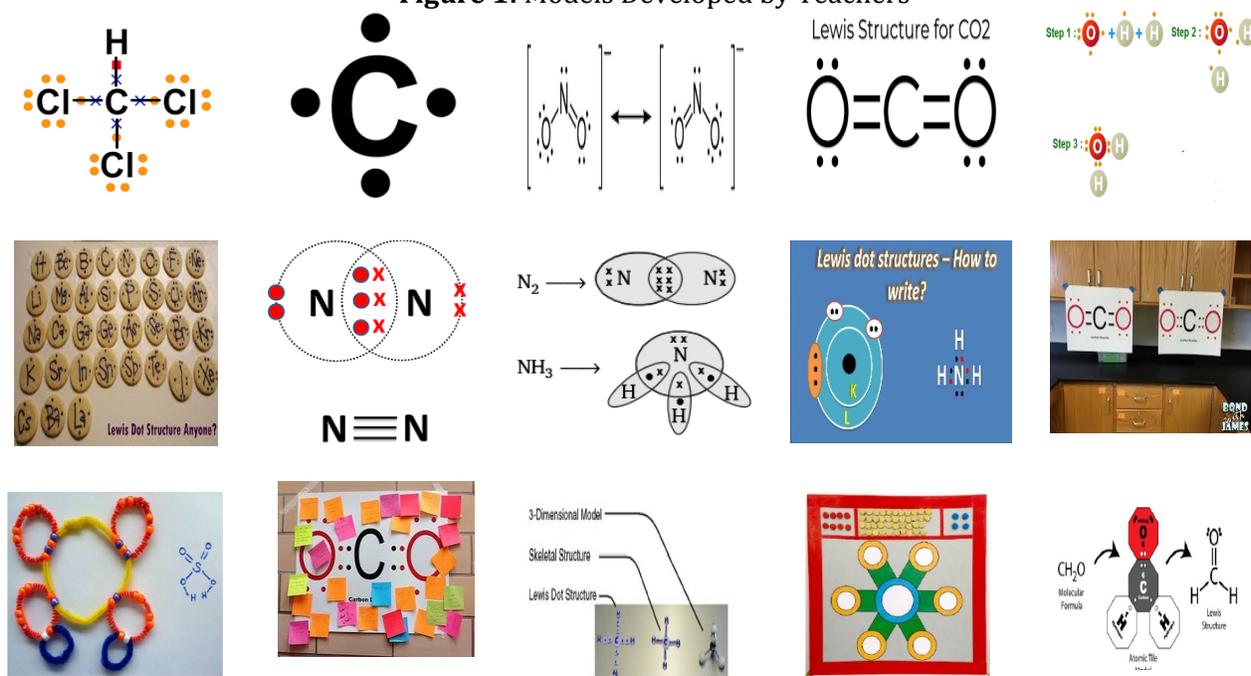
The following research hypotheses are fabricated to guide the study:

H₀₁: There is no noteworthy difference between the scores of the formative assessment conducted before the treatment and after the treatment.

H₀₂: There is noteworthy difference between the scores of the formative assessment conducted before the treatment and after the treatment.

Hypotheses test is applied to investigate the effectiveness of the Lewis dot structure model made by teachers to teach Lewis structure among Senior Secondary school students in Chemistry and its effectiveness to enhance the conceptual understanding to acquire specific learning outcomes. If the significant value is greater than 0.05 and the t-critical value is less than t value then the null hypotheses are accepted. If the significant value is less than 0.05 and t-critical value is less than t, then the null hypotheses are rejected.

Figure 1: Models Developed by Teachers



3. RESULT AND DISCUSSIONS

Table 3: Students' formative assessment score before and after the treatment

Student No	Score Before Treatment	Score After Treatment	Improved Score
1	48	94	0.757
2	31	81	.603
3	34	78	.546
4	28	84	.656
5	28	78	.574
6	18	81	.648
7	31	76	.532
8	38	76	.502
9	38	84	.620
10	41	84	.616

11	41	76	.473
12	41	86	.672
13	31	78	.570
14	41	81	.556
15	24	76	.564
16	28	81	.614
17	31	77	.560
18	48	91	.711
19	28	54	.311
20	58	91	.656
21	28	76	.547
22	41	81	.556
23	44	81	.538
24	31	76	.532
25	41	76	.472
26	31	81	.532
27	34	76	.601
28	34	76	.516
29	28	88	.711
30	31	76	.533
31	32	76	.533
32	38	74	.461
33	24	76	.564
34	30	76	.532
35	40	75	.462
Average	34.65	79.17	0.566

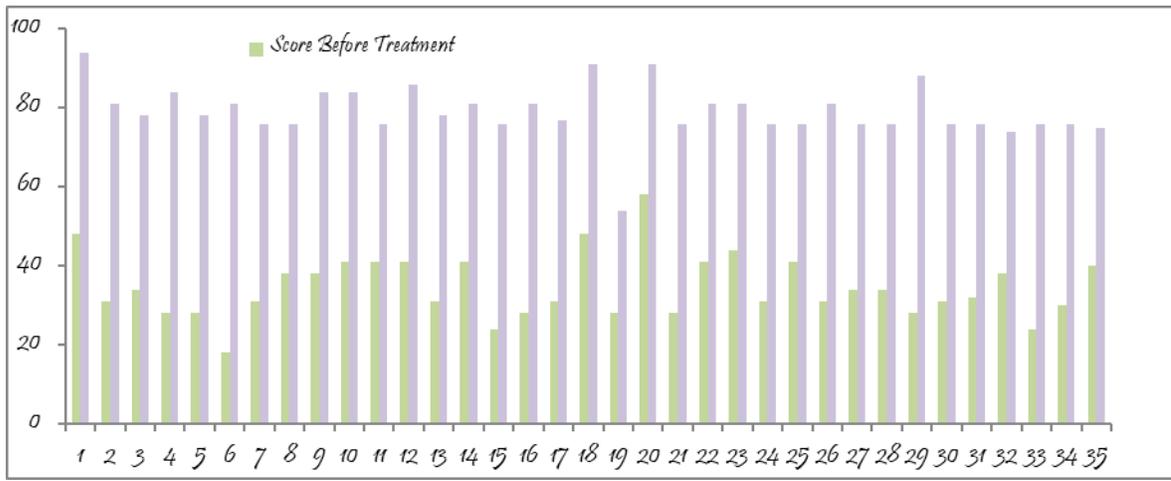


Figure 3: Formative assessment score – before and after treatment

Table 4: Paired sample t-test result

Paired Differences				95% confidence interval of sig		t	df	Significance 2-tail
Paired 1 pre-test/post -test /cognitive and critical value	Mean	SD	Standard Mean	Lower	Upper			
-2.36	44.25	6.45	1,149	47.016	42.194	37.194	3.3	.000

The central aim of this paper is to observe the effectiveness of the model made by teachers to teach Lewis dot structure. The experiential learning activity- teacher made model is effective to enhance learner's score in the formative assessment after the treatment and paired sample t- analysis. Table 3 and fig 2 illustrates the learners score before the treatment, after the treatment and their improved score. Mean score of the formative assessment before the treatment is 34.65 and after the treatment is 79.17 the result of the present study clearly depicts that the scores have increased in the test after the experiential learning activity (mean = 44.25). The fig 2 illustrates that the experiential learning activity has enhanced the scores of all students. The result of the study illustrates that the two students who score very low in the formative assessment before the treatment has gained more score after the treatment.

Paired sample t-analysis is used to investigate the effectiveness of teachers' design of Lewis dot structure through experiential learning activities and to find the difference in the attainment of specific learning outcomes. Table 3 illustrates the data analysis done by using SPSS.

Table- 4 explicit that t value 37.194 is less than the critical value -2.36 and so the null hypothesis: "There is no noteworthy difference between the scores of the formative assessment conducted before the treatment and after the treatment" is rejected. It is clearly evident that there is noteworthy difference in the learner's cognitive ability in the attainment of specific learning objectives and conceptual understanding. The gain score analysis is also conducted in addition to the paired sample t test analysis and the learners' gain score is presented in table 2. The outcome of the table clearly shows that the mean of the gained score of the learner's cognitive attainment of specific learning outcome is .566. Table 2 illustrates that the gain score comes under moderate level. Effective learning activities based on Lewis dot structure has moderate effect on the learners' score, this is due to the learners' difference in understanding the concept.

4. CONCLUSION

On the basis of the result of the study and the discussion it is concluded that teacher designed model of Lewis dot structure in the present study is effective in the attainment of specific learning outcome and conceptual cognitive learning and understanding. It is shown by:

- 1) Enhancement of the scores in the formative assessment after the treatment by 46%.
- 2) Paired sample t analysis result shows that t value is less than the t critical value and hence there is a noteworthy difference in the performance before and after the treatment.
- 3) Gained score in the formative assessment after the treatment is 68% and it falls under moderate category.

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CONFLICT OF INTEREST

The author have declared that no competing interests exist.

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REFERENCES

- [1] Prashant Thote, Experiential Learning: Inclusive Art Education for Joyful Learning, Review of Research, Vol 8, Issue- 09, June 2019.
- [2] Prashant Thote, Experiential Learning: Model for Teaching Science at Grade Nine, Research Magma, Vol-3, Issue -06, August – 2019.

- [3] Prashant Thote, An Analysis of Impact of Evidence Based Learning on Academic Achievement of Students, International Journal of Research- Granthaalayah, Vol 8, Issue- 08, August 2020.
- [4] Prashant Thote, Experiential Learning: An Analysis of Impact on Academic Achievement Among Students of Grade 12, International Journal of Research- Granthaalayah, Vol 8, Issue- 09, September 2020.
- [5] Prashant Thote, Evidence Based Learning: An Analysis of Impact on Retention of Knowledge, International Journal of Research- Granthaalayah, Vol 8, Issue- 10, October 2020.
- [6] Prashant Thote, Outcome Based Learning: An Analysis of Impact on Academic Achievement Among School Students, International Journal of Research- Granthaalayah, Vol 8, Issue- 11, November 2020.
- [7] Prashant Thote, Evidence Based Learning: An Analysis of Impact of Remedial Teaching on Conceptual Understanding, International Journal of Research- Granthaalayah, Vol 8, Issue- 12, December 2020.
- [8] Prashant Thote, Evidence Based Learning: An Analysis of Impact of Experiential Learning on Attainment of Intended Specific Learning Outcome, International Journal of Research- Granthaalayah, Vol 9, Issue- 1, January 2021.
- [9] Prashant Thote, Evidence Based Learning: A Study of Impact of Experiential Learning Activities on Attainment of Specific Learning Outcomes, International Journal of Research- Granthaalayah, Vol 9, Issue- 2, February 2021.