

ANALYSIS OF GAPS IN CONTENTS AND TEACHING STRATEGIES ON THE CHEMISTRY CURRICULUM UNDER WBCHSE

Palash Das

Assistant Professor, Erstwhile David Hare Training College(WBUTTEPA), Kolkata

Dr Rajiba Lochon Mahapatra

Assistant Professor, Department of Education, The University of Burdwan

Abstract

Chemistry Education includes the study of chemistry in all the sections of school education as well as higher education (both colleges and universities). The effective learning of chemistry for the students depends on the various factors such as cognitive ability of the students, curriculum, teaching strategies applied in the class rooms and so on. In this teaching-learning process, the subject teachers play an important role for the proper implementation of curriculum in the real class room situations. This study investigates to identify the gaps in contents of chemistry curriculum under the West Bengal Council of Higher Secondary Education (WBCHSE) and also in the teaching strategies which are generally applied in the class rooms. In this study, the analysis of gaps in contents were made on the basis of the difference between the expected and actually present units as mentioned in the chemistry curriculum. And the analysis of gaps in teaching strategies were made on the basis of difference between the expected and the applied teaching strategies for the specific subunits of chemistry curriculum. This study was conducted on the 58 experienced chemistry teachers from different districts in West Bengal. The self-made feedback formats validated by the concerned subject experts were used for this study. After collecting the feedbacks from the concerned subject teachers, the normality testing procedures were applied on the obtained data. On the basis of results obtained from the normality testing, the statistical analysis was done by t-test and chi-square tests as parametric and non-parametric tests respectively. The results have been found that there are significant content and teaching gaps in the respective units and sub-units of the chemistry curriculum under WBCHSE.

Key Words: Chemistry Education, Teaching Gaps, Content gaps, WBCHSE.

I. Introduction

The main objectives of chemistry education are to expedite the knowledge about the principles of chemistry for understanding himself and his environment. This is one of the highly useful subjects which help the learner to understand the material world better. In West Bengal chemistry is a part of physical science at the secondary level but it is a compulsory subject like Mathematics, Physics, and Biology at the higher secondary level.

The process of teaching-learning of science is a very complex one. This process involves learner, teacher, teaching-learning materials, suitable approaches and strategies and conducive learning environment leading to meaningful

learning. Learner is at the core of learning process and teacher plays the role of the facilitator of learning. The teaching of chemistry employs a number of strategies. Stones and Morris define teaching strategy as “a generalized plan for a lesson which includes structure, desired learning behavior in terms of the goals of instruction and an outline of planned tactics necessary to implement the strategy” (cited in Sharma, 2003). A chemistry teacher can adopt several methods, techniques and models as teaching strategies. Strategies of teaching helps us to make decision on how to initiate teaching process to engage learners; how to transact the concept and what teaching-learning materials can be chosen to make transaction enjoyable and learning meaningful. It is evident from several studies that different learners have different learning styles and learn differently. They come to the class with some prior knowledge about the natural world around them. Therefore, it is imperative that a teacher has to consider about various strategies of learning to cater to the learning needs and learning styles of all learners.

II. Significance of the study

In the curriculum of West Bengal Council of Higher Secondary Education (WBCHSE) Chemistry Subject has been included as a separate discipline which is taught to the pupils as a part of the Physical Science Curriculum up to the Secondary Level. From primary to secondary education, in the curriculum under WB Boards, there are some content areas in which the scopes for learning chemistry are present for the students (Das and Mahapatra 2018). The knowledge of chemistry learns by the students as a separate discipline at the higher secondary level. So to perform well, up to the level of learning of chemistry in the Higher Education (College and University), students must have clear concept about the different units of Chemistry at the Higher Secondary level. This is one of the important reason for getting interest to the investigator to find out the lacunae or gaps in our teaching learning situation of Chemistry Education.

Chemistry has a major impact on modern life. Lack of proper cognitive skills of the students has the potential role to disrupt the learning process in chemistry. Researchers have found that it can also have a negative effect on learning outcomes. This, in turn, increases students' frustration and have not any satisfactory effect on the learning experience of chemistry in school education. The curriculum should be designed so that the amount of cognitive process required for learning at any one time does not exceed the learner's mental processing capacity. The duties and responsibilities of the teachers today become more significant in transforming the traditional approaches of teaching into the innovative approaches that take into account needs, abilities and interests of learners. So the proper content areas and also the suitable teaching method for specific content are very much necessary for the effective learning of chemistry for the students.

III. Objectives of the study:

1. To identify gaps in contents in chemistry syllabus under WBCHSE.
2. To identify the gaps in teaching strategies for the specific sub-units in chemistry syllabus under WBCHSE.
3. To analyse the content gaps in chemistry syllabus under WBCHSE.
4. To analyse the teaching gaps in specific subunits in chemistry syllabus under WBCHSE.

IV. Assumption of the study:

Gaps in contents and teaching strategies for specific sub-units in chemistry curriculum can be identified from the feedback of different experienced chemistry teachers based on a pilot study among the different in-service as well as trainee teachers having at least PG/Hons degree in Chemistry with B.Ed.

V. Research Questions:

On the basis of the assumption of the study the following research questions have been formulated.

1. Are the feed backs collected from the teachers for the identification of content gaps in the chemistry curriculum under WBCHSE, following the normality?
2. Are the feed backs collected from the teachers for the identification of teaching gaps in the chemistry curriculum under WBCHSE, following the normality?
3. What percentage of gaps are present in the contents of chemistry curriculum under WBCHSE?.

VI. Hypotheses:

H01: There is no significant content gaps between the expected units and the existing units in the curriculum of Chemistry under WBCHSE.

H02: There is no significant teaching gaps between the expected and applied teaching strategies in the respective subunits in the prescribed chemistry curriculum under WBCHSE.

VII. Delimitation of the study:

Serial No.	Delimited areas	Description
	Board/Council	This study could be done on all boards at H.S. level in India. But considering the scopes and facilities, it has been delimited to conduct this study on the Curriculum affiliated to the West Bengal Council of Higher Secondary Education (WBCHSE).
	Curriculum area	The study has been delimited to only the theoretical part of the chemistry curriculum under WBCHSE.
	Institution	This study could be conducted with any types of higher secondary schools .But due to availability and feasibility of the samples only Bengali medium higher secondary schools were selected for this study.
	Areas of gaps	The study could be conducted on all areas of gaps existed in the school education system, curriculum pattern, teaching strategies, learning areas, school environment ,pupils' attitude and interest etc. But to make the study comprehensive two areas

		namely, gaps in content under the chemistry curriculum gaps in strategies of teaching for specific sub-units in chemistry curriculum at higher secondary level were selected for this study.
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VIII: Methodology:

VIII.1: Population: All the chemistry teachers of higher secondary schools under West Bengal Council of Higher Secondary Education (WBCHE) may be considered as the population of this study.

VIII.2: Sample:

For the collection of feedback from the chemistry teachers, systematic multistage random sampling techniques were adopted and the 10 districts were randomly selected for the collection of sample. For identification of gaps in teaching and content, initially 90 schools affiliated to WBCHE, were selected to distribute the feedback formats among the chemistry teachers(both male and female) teaching at higher secondary level (as mentioned in the Table No. 1).The schools were selected randomly from the different districts as mentioned below. But finally 58(Fifty Eight) filled-in formats were collected for the study.

To select the Chemistry teachers the following points were considered:

- i) The teacher must have at least five years' experience in teaching chemistry at Higher Secondary Level.
- ii) The teacher must have a training course (B.T/B.Ed) with Physical Science as method subject.
- iii) The teacher must have at least Hons/ Post graduate degree in Chemistry.

VIII.3: Sampling design for the number of chemistry teachers collected from different H.S. Schools under different districts:

Table No.1

Sl No.	District	Total No. of selected schools	No. of selected teachers having Chemistry Hons/PG with B.ED/B.T Experience		Total No. of selected teachers
			Above five years	Above Ten years	
1.	Hooghly	09	03	05	08
2.	Nadia	08	01	02	03
3.	Kolkata	09	02	05	07
4.	Howrah	10	01	04	05
5.	South-24 Parganas	08	02	03	05

6.	Purbo Midnapur	11	03	04	07
7.	Burdwan	07	01	04	05
8.	Bankura	09	02	03	05
9.	Malda	11	03	05	08
10.	Murshidabad	08	02	03	05
Total		90	20	38	58

VIII.4: Variables of the study:

Variables	Description
Independent	The independent variables for the present study are the gender, geographical areas, academic qualification, teaching experience of the surveyed teachers teaching chemistry at the Higher Secondary level in the different Schools in different districts under the WBCHSE
Dependent	The dependent variable for the present study is the feedback from the students as well as Chemistry teachers at Higher Secondary Level under WBCHSE.

VIII.5: Operational Definitions of the study:

- a) **Gaps:** It is the difference between the expected and actual performance in any area of teaching situation. For learning gap, it will consider for the performance of students in leaning contents. Those areas of cognitive domain can be measured through the test of performance on the learning unit. In terms of behavioral objectives of teaching maximization of learning is considered as the expected out comes from the teaching learning process.
- b) **Content:** Syllabus is the part of a curriculum for a specific discipline. In this study content which constitute the syllabus of chemistry curriculum under West Bengal Council of Higher Secondary Education. Here content is considered for the particular unit of class XII under the chemistry syllabus.
- c) **Strategy:** According to Dictionary of education, 'Strategy is the techniques used in learning or thinking'. Strategy is an integral part of education for the transaction of curriculum with minimum learning gaps within a schedule time. It is combination of different sets of activities such of analysis of contents, preparation of learning materials, planning and presentation of learning materials to achieve a particular teaching goal.

IX: Administration of tools:

Two separate feedback formats (namely FICG and FITG) were prepared on the basis of pilot study on 30 B.Ed and M.ED students having Physical Science as a method subject. Then these were validated by the concern subject experts. The tool FICG was prepared as per the Likart Five Point scale and the FITG was prepared on the two point

scale. For identification of content gaps total theoretical chemistry syllabus of class XI and XII have been divided into 30 units and for the identification of teaching gaps total 30 units chemistry syllabus have been sub divided into 192 sub-units. After necessary validation of the tools, these were administered on the selected sample and the data were collected on the basis of Filled-in specific format as the responses given from them. The sample format of the tools are given below:

IX.1: FICG: Feedback Format for identification of Content Gaps:

Unit No.	Unit Name	Sub-Units		Feed back				
		Sub-Units Actually Present	Expected Sub-units to be modified	Strongly Agree (5)	Agree (4)	No Comment (3)	Disagree (2)	Strongly Disagree (1)

IX.2: FITG: Feedback format for the identification of teaching gaps:

Unit Name	Sub-Unit Name	Teaching Strategies	Feed back							
		Proposed teaching strategies	Teaching strategies applied	IF NO WHAT SHOULD BE APPLIED						
			Yes (1)	No (2)	Lecture	Demonstration	Lab	Other(Please specify)		

X. Results:

The collected data were analysed through MS-Excel 2007 and SPSS version 20. After analysis of data following results were obtained:

1. Pertaining to Research Questions No.1:

The research question was, ‘Are the feed backs collected from the teachers for the identification of content gaps in the chemistry curriculum under WBCHSE, following the normality?’

Results obtained from normality testing:

Table: 02

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
TOTALSCORE	58	13.7%	365	86.3%	423	100.0%

Table: 03

Descriptive statistics

		Statistic	Std. Error
TOTALSCORE	Mean	117.16	1.654
	95% Confidence Interval for Mean	Lower Bound 113.84 Upper Bound 120.47	
	5% Trimmed Mean	117.75	
	Median	120.00	
	Variance	158.660	
	Std. Deviation	12.596	
	Minimum	86	
	Maximum	137	
	Range	51	
	Interquartile Range	18	
	Skewness	-.693	.314
	Kurtosis	-.174	.618

Table: 04

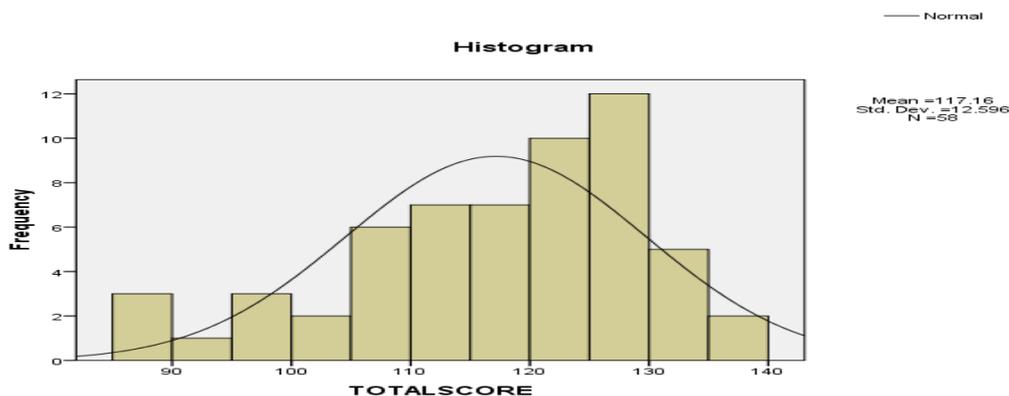
Tests of Normality

	Kolmogorov-Smirnov ^a			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.

TOTALSCORE	.120	58	.037	.949	58	.016
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a. Lilliefors Significance Correction

Histogram of the result:



2. Pertaining to Research Questions No.2:

The research question was, ‘Are the feed backs collected from the teachers for the identification of teaching gaps in the chemistry curriculum under WBCHSE, following the normality?’

Results obtained from normality testing:

Table 05: Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
TOTALSCORE	58	13.7%	365	86.3%	423	100.0%

Table : 06 Descriptive statistics

	Statistic	Std. Error
TOTALSCORE Mean	256.59	1.576
95% Confidence Interval Lower Bound	253.43	

for Mean	Upper Bound	259.74	
5% Trimmed Mean		256.37	
Median		256.00	
Variance		144.106	
Std. Deviation		12.004	
Minimum		233	
Maximum		286	
Range		53	
Interquartile Range		15	
Skewness		.310	.314
Kurtosis		-.185	.618

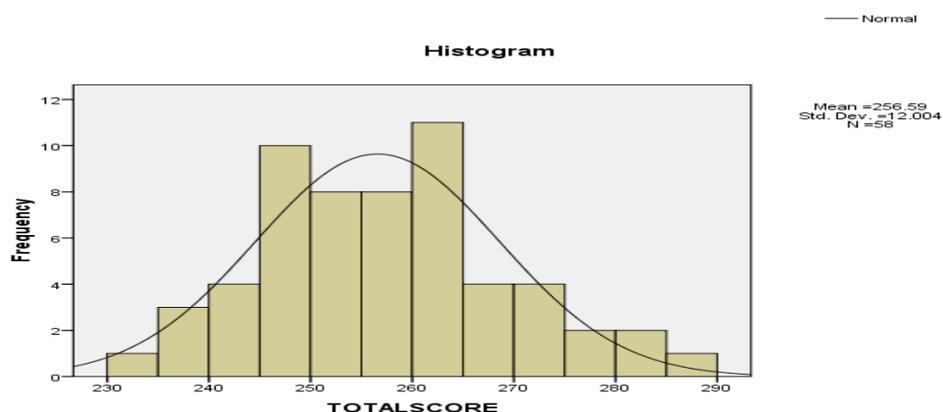
Table :07 Tests of Normality

	Kolmogorov-Smirnov ^a			Shapiro-Wilk*		
	Statistic	df	Sig.	Statistic	df	Sig.
TOTALSCOR E	.072	58	.200*	.984	58	.654

a. Lilliefors Significance Correction

*. This is a lower bound of the true significance.

Histogram of the results:



3. Pertaining to Research Questions No.3:

The research question was, “What percentage of gaps are present in the contents of chemistry curriculum under WBCHSE”?

Table: 08: Results obtained from Item wise analysis for the percentage of weightage for content gaps in H.S. Curriculum under WBCHSE:

Unit	Title of the Unit	Require no. of Sub units in the syllabus	No. of subunits actually present In the chemistry text books	Weightage of gaps present in existing subunits	Weightage of gaps in percentage (%)
U1	Some Basic Concepts of Chemistry	06	05	01	16.66
U2	Structure of Atom	11	09	02	18.18
U3	Classification of elements & Periodicity in properties	05	04	01	20.00
U4	Chemical Bonding & Molecular Structure	13	10	03	23.07
U5	States of Matter : Gases & Liquids	12	09	03	25.00
U6	Chemical Thermodynamics	16	12	04	15.00
U7	Equilibrium	15	12	03	20.00
U8	Redox Reactions	04	03	01	25.00
U9	Hydrogen	10	08	02	20.00
U10	S-Block Elements	06	05	01	16.66
U11	p-Block Elements	05	04	01	20.00
U12	Organic Chemistry: Basic Principles & Techniques	10	09	01	10.00
U13	Hydrocarbons	06	04	02	33.33
U14	Environmental Chemistry	07	05	02	28.57
U15	Solid State	07	04	03	42.85
U16	Solutions	09	07	02	22.22
U17	Electrochemistry	10	09	01	10.00
U18	Chemical Kinetics	09	08	01	11.11
U19	Surface Chemistry	07	06	01	14.28

U20	General Principles and Process of Isolation of Elements	07	05	02	28.57
U21	p-Block Elements	10	10	00	00.00
U22	d-& f-Block Elements	07	05	02	28.57
U23	Co-ordination Compounds	08	07	01	12.50
U24	Haloalkanes & Haloarenes	10	09	01	10.00
U25	Alcohols, Phenols and Ethers	12	07	05	41.66
U26	Aldehydes, Ketones and Carboxylic Acids	12	06	06	50.00
U27	Organic Compounds Containing Nitrogen	17	09	08	47.05
U28	Bio molecules	10	09	01	10.00
U29	Polymers	06	04	02	33.33
U30	Chemistry in Everyday Life	04	03	01	25.00
Total		271	209	62	22.87

3: Pertaining to H01:

The hypothesis was, “**there is no significant content gaps between the expected units and the existing units in the curriculum of Chemistry under WBCHSE**”.

Since the obtained data were not obeying the normality, so the Chi-Square analysis on the individual 30 units were designed for identification of content gaps in the prescribed chemistry syllabus under WBCHSE. The data were analyzed through M.S. Excel software. The unit wise result obtained from Chi-Square analysis are as follows:

Table No.:09 : RESULTS OBTAINED FROM UNIT WISE CHI-SQUARE ANALYSIS ON CHEMISTRY CURRICULUM:

UNIT	RESPONSE	fo	fe	fo-fe	(fo-fe) ²	(fo-fe) ² /fe
UNIT-1	SA	17	11.6	5.4	29.16	2.513793103
	A	32	11.6	20.4	416.16	35.87586207
	NC	0	11.6	-11.6	134.56	11.6
	D	8	11.6	-3.6	12.96	1.117241379
	SD	1	11.6	-10.6	112.36	9.686206897
	TOTAL	58	58			60.79310345
UNIT-2	SA	21	11.6	9.4	88.36	7.617241379

	A	26	11.6	14.4	207.36	17.87586207
	NC	0	11.6	-11.6	134.56	11.6
	D	8	11.6	-3.6	12.96	1.117241379
	SD	3	11.6	-8.6	73.96	6.375862069
	TOTAL	58	58			44.5862069
UNIT-3	SA	22	11.6	10.4	108.16	9.324137931
	A	32	11.6	20.4	416.16	35.87586207
	NC	0	11.6	-11.6	134.56	11.6
	D	4	11.6	-7.6	57.76	4.979310345
	SD	0	11.6	-11.6	134.56	11.6
	TOTAL	58	58			73.37931034
UNIT-4	SA	17	11.6	5.4	29.16	2.513793103
	A	34	11.6	22.4	501.76	43.25517241
	NC	0	11.6	-11.6	134.56	11.6
	D	4	11.6	-7.6	57.76	4.979310345
	SD	3	11.6	-8.6	73.96	6.375862069
	TOTAL	58	58			68.72413793
UNIT-5	SA	22	11.6	10.4	108.16	9.324137931
	A	27	11.6	15.4	237.16	20.44482759
	NC	0	11.6	-11.6	134.56	11.6
	D	6	11.6	-5.6	31.36	2.703448276
	SD	3	11.6	-8.6	73.96	6.375862069
	TOTAL	58	58			50.44827586
UNIT-6	SA	18	11.6	6.4	40.96	3.531034483
	A	33	11.6	21.4	457.96	39.47931034
	NC	0	11.6	-11.6	134.56	11.6
	D	7	11.6	-4.6	21.16	1.824137931
	SD	0	11.6	-11.6	134.56	11.6
	TOTAL	58	58			68.03448276
UNIT-7	SA	19	11.6	7.4	54.76	4.720689655
	A	30	11.6	18.4	338.56	29.1862069
	NC	3	11.6	-8.6	73.96	6.375862069
	D	3	11.6	-8.6	73.96	6.375862069
	SD	3	11.6	-8.6	73.96	6.375862069
	TOTAL	58	58			53.03448276

UNIT-8	SA	20	11.6	8.4	70.56	6.082758621
	A	29	11.6	17.4	302.76	26.1
	NC	1	11.6	-10.6	112.36	9.686206897
	D	6	11.6	-5.6	31.36	2.703448276
	SD	2	11.6	-9.6	92.16	7.944827586
	TOTAL	58	58			52.51724138
UNIT-9	SA	14	11.6	2.4	5.76	0.496551724
	A	35	11.6	23.4	547.56	47.20344828
	NC	1	11.6	-10.6	112.36	9.686206897
	D	7	11.6	-4.6	21.16	1.824137931
	SD	1	11.6	-10.6	112.36	9.686206897
	TOTAL	58	58			68.89655172
UNIT-10	SA	19	11.6	7.4	54.76	4.720689655
	A	29	11.6	17.4	302.76	26.1
	NC	1	11.6	-10.6	112.36	9.686206897
	D	6	11.6	-5.6	31.36	2.703448276
	SD	3	11.6	-8.6	73.96	6.375862069
	TOTAL	58	58			49.5862069
UNIT-11	SA	17	11.6	5.4	29.16	2.513793103
	A	30	11.6	18.4	338.56	29.1862069
	NC	1	11.6	-10.6	112.36	9.686206897
	D	6	11.6	-5.6	31.36	2.703448276
	SD	4	11.6	-7.6	57.76	4.979310345
	TOTAL	58	58			49.06896552
UNIT-12	SA	15	11.6	3.4	11.56	0.996551724
	A	31	11.6	19.4	376.36	32.44482759
	NC	0	11.6	-11.6	134.56	11.6
	D	8	11.6	-3.6	12.96	1.117241379
	SD	4	11.6	-7.6	57.76	4.979310345
	TOTAL	58	58			51.13793103
UNIT-13	SA	20	11.6	8.4	70.56	6.082758621
	A	25	11.6	13.4	179.56	15.47931034
	NC	1	11.6	-10.6	112.36	9.686206897
	D	9	11.6	-2.6	6.76	0.582758621
	SD	3	11.6	-8.6	73.96	6.375862069

	TOTAL	58	58			38.20689655
UNIT-14	SA	17	11.6	5.4	29.16	2.513793103
	A	23	11.6	11.4	129.96	11.20344828
	NC	0	11.6	-11.6	134.56	11.6
	D	13	11.6	1.4	1.96	0.168965517
	SD	5	11.6	-6.6	43.56	3.755172414
	TOTAL	58	58			29.24137931
UNIT-15	SA	22	11.6	10.4	108.16	9.324137931
	A	21	11.6	9.4	88.36	7.617241379
	NC	0	11.6	-11.6	134.56	11.6
	D	8	11.6	-3.6	12.96	1.117241379
	SD	7	11.6	-4.6	21.16	1.824137931
	TOTAL	58	58			31.48275862
UNIT-16	SA	16	11.6	4.4	19.36	1.668965517
	A	28	11.6	16.4	268.96	23.1862069
	NC	1	11.6	-10.6	112.36	9.686206897
	D	5	11.6	-6.6	43.56	3.755172414
	SD	8	11.6	-3.6	12.96	1.117241379
	TOTAL	58	58			39.4137931
UNIT-17	SA	20	11.6	8.4	70.56	6.082758621
	A	25	11.6	13.4	179.56	15.47931034
	NC	1	11.6	-10.6	112.36	9.686206897
	D	8	11.6	-3.6	12.96	1.117241379
	SD	4	11.6	-7.6	57.76	4.979310345
	TOTAL	58	58			37.34482759
UNIT-18	SA	14	11.6	2.4	5.76	0.496551724
	A	30	11.6	18.4	338.56	29.1862069
	NC	1	11.6	-10.6	112.36	9.686206897
	D	9	11.6	-2.6	6.76	0.582758621
	SD	4	11.6	-7.6	57.76	4.979310345
	TOTAL	58	58			44.93103448
UNIT-19	SA	15	11.6	3.4	11.56	0.996551724
	A	29	11.6	17.4	302.76	26.1
	NC	1	11.6	-10.6	112.36	9.686206897
	D	6	11.6	-5.6	31.36	2.703448276

	SD	7	11.6	-4.6	21.16	1.824137931
	TOTAL	58	58			41.31034483
UNIT-20	SA	19	11.6	7.4	54.76	4.720689655
	A	26	11.6	14.4	207.36	17.87586207
	NC	1	11.6	-10.6	112.36	9.686206897
	D	8	11.6	-3.6	12.96	1.117241379
	SD	4	11.6	-7.6	57.76	4.979310345
	TOTAL	58	58			38.37931034
UNIT-21	SA	25	11.6	13.4	179.56	15.47931034
	A	21	11.6	9.4	88.36	7.617241379
	NC	2	11.6	-9.6	92.16	7.944827586
	D	8	11.6	-3.6	12.96	1.117241379
	SD	2	11.6	-9.6	92.16	7.944827586
	TOTAL	58	58			40.10344828
UNIT-22	SA	16	11.6	4.4	19.36	1.668965517
	A	32	11.6	20.4	416.16	35.87586207
	NC	0	11.6	-11.6	134.56	11.6
	D	5	11.6	-6.6	43.56	3.755172414
	SD	5	11.6	-6.6	43.56	3.755172414
	TOTAL	58	58			56.65517241
UNIT-23	SA	18	11.6	6.4	40.96	3.531034483
	A	34	11.6	22.4	501.76	43.25517241
	NC	0	11.6	-11.6	134.56	11.6
	D	4	11.6	-7.6	57.76	4.979310345
	SD	2	11.6	-9.6	92.16	7.944827586
	TOTAL	58	58			71.31034483
UNIT-24	SA	16	11.6	4.4	19.36	1.668965517
	A	32	11.6	20.4	416.16	35.87586207
	NC	0	11.6	-11.6	134.56	11.6
	D	5	11.6	-6.6	43.56	3.755172414
	SD	5	11.6	-6.6	43.56	3.755172414
	TOTAL	58	58			56.65517241
UNIT-25	SA	19	11.6	7.4	54.76	4.720689655
	A	30	11.6	18.4	338.56	29.1862069
	NC	0	11.6	-11.6	134.56	11.6

	D	8	11.6	-3.6	12.96	1.117241379
	SD	1	11.6	-10.6	112.36	9.686206897
	TOTAL	58	58			56.31034483
UNIT-26	SA	24	11.6	12.4	153.76	13.25517241
	A	26	11.6	14.4	207.36	17.87586207
	NC	0	11.6	-11.6	134.56	11.6
	D	5	11.6	-6.6	43.56	3.755172414
	SD	3	11.6	-8.6	73.96	6.375862069
	TOTAL	58	58			52.86206897
UNIT-27	SA	17	11.6	5.4	29.16	2.513793103
	A	35	11.6	23.4	547.56	47.20344828
	NC	0	11.6	-11.6	134.56	11.6
	D	4	11.6	-7.6	57.76	4.979310345
	SD	2	11.6	-9.6	92.16	7.944827586
	TOTAL	58	58			74.24137931
UNIT-28	SA	14	11.6	2.4	5.76	0.496551724
	A	34	11.6	22.4	501.76	43.25517241
	NC	1	11.6	-10.6	112.36	9.686206897
	D	9	11.6	-2.6	6.76	0.582758621
	SD	0	11.6	-11.6	134.56	11.6
	TOTAL	58	58			65.62068966
UNIT-29	SA	14	11.6	2.4	5.76	0.496551724
	A	33	11.6	21.4	457.96	39.47931034
	NC	0	11.6	-11.6	134.56	11.6
	D	8	11.6	-3.6	12.96	1.117241379
	SD	3	11.6	-8.6	73.96	6.375862069
	TOTAL	58	58			59.06896552
UNIT-30	SA	16	11.6	4.4	19.36	1.668965517
	A	29	11.6	17.4	302.76	26.1
	NC	1	11.6	-10.6	112.36	9.686206897
	D	11	11.6	-0.6	0.36	0.031034483
	SD	1	11.6	-10.6	112.36	9.686206897
	TOTAL	58	58			47.17241379

Degrees of freedom (df) for every unit : $(5-1) \times (2-1) = 4$

4: Pertaining to Ho2:

The hypothesis was. “There is no significant teaching gaps between the expected and applied teaching strategies in the respective subunits in the prescribed chemistry curriculum under WBCHSE”.

Table No. 10 : Results of t-Test on 192 subunits of chemistry curriculum:

SUB- UNIT	F	Sig	t-value	df	Sig. (2-tailed)
SU-1	9.623	.003	11.247	56	.000
SU-2	.484	.489	0.345	56	.731
SU-3	.002	.964	0.801	56	.427
SU-4	4.110	.047	0.506	56	.615
SU-5	.291	.592	1.112	56	.271
SU-6	8.000	.006	0.688	56	.494
SU-7	2.109	.152	0.917	56	.363
SU-8	.048	.827	1.766	56	.083
SU-9	1.383	.245	2.093	56	.041
SU-10	1.176	.283	0.377	56	.707
SU-11	1.532	.221	1.319	56	.193
SU-12	4.439	.040	1.354	56	.181
SU-13	.379	.541	0.454	56	.652
SU-14	.087	.769	0.127	56	.899
SU-15	3.576	.064	1.017	56	.314
SU-16	3.161	.081	.000	56	1.000
SU-17	.454	.503	1.337	56	.187
SU-18	.479	.492	2.531	56	.014
SU-19	1.658	.203	0.402	56	.690
SU-20	1.916	.172	.184	56	.854
SU-21	.908	.345	1.871	56	.067
SU-22	.016	.899	.870	56	.388
SU-23	6.761	.012	1.174	56	.245
SU-24	.291	.592	0.087	56	.931
SU-25	.018	.893	0.300	56	.765
SU-26	.906	.345	.433	56	.667
SU-27	.986	.325	0.446	56	.658
SU-28	.310	.580	1.353	56	.182
SU-29	1.095	.300	1.733	56	.089

SU-30	.339	.563	0.392	56	.697
SU-31	.157	.694	1.094	56	.278
SU-32	.104	.748	1.540	56	.129
SU-33	.066	.798	1.300	56	.199
SU-34	.371	.545	.573	56	.569
SU-35	2.350	.131	.195	56	.846
SU-36	.514	.476	0.117	56	.907
SU-37	.954	.333	1.434	56	.157
SU-38	1.747	.192	.064	56	.950
SU-39	.033	.856	.069	56	.945
SU-40	1.280	.263	.464	56	.645
SU-41	7.107	.010	0.226	56	.822
SU-42	1.359	.249	1.451	56	.152
SU-43	2.960	.091	0.241	56	.810
SU-44	.376	.542	0.656	56	.514
SU-45	.824	.368	1.107	56	.273
SU-46	.052	.821	.448	56	.656
SU-47	1.926	.171	1.558	56	.125
SU-48	2.784	.101	0.585	56	.561
SU-49	2.500	.119	0.146	56	.884
SU-50	1.067	.306	.143	56	.887
SU-51	.254	.616	.298	56	.767
SU-52	.434	.513	.217	56	.829
SU-53	.078	.781	1.423	56	.160
SU-54	.264	.609	.549	56	.585
SU-55	1.072	.305	1.571	56	.122
SU-56	1.493	.227	2.124	56	.038
SU-57	.782	.380	.720	56	.474
SU-58	.470	.496	.282	56	.779
SU-59	.008	.931	1.500	56	.139
SU-60	.023	.880	1.489	56	.142
SU-61	.412	.523	.429	56	.670
SU-62	.048	.828	.264	56	.793
SU-63	1.328	.254	1.011	56	.317
SU-64	1.927	.171	1.677	56	.099

SU-65	1.231	.272	.094	56	.926
SU-66	18.992	.000	0.743	56	.461
SU-67	.399	.530	.132	56	.895
SU-68	3.675	.060	0.202	56	.841
SU-69	2.674	.108	1.451	56	.152
SU-70	3.644	.061	.313	56	.755
SU-71	.079	.780	1.540	56	.129
SU-72	5.627	.021	.062	56	.951
SU-73	.010	.923	.996	56	.324
SU-74	.021	.886	.816	56	.418
SU-75	.674	.415	.681	56	.498
SU-76	.116	.735	0.573	56	.569
SU-77	1.206	.277	.171	56	.865
SU-78	5.573	.022	.171	56	.865
SU-79	1.698	.198	.047	56	.963
SU-80	1.567	.216	.523	56	.603
SU-81	.903	.346	0.684	56	.497
SU-82	.045	.833	.965	56	.339
SU-83	.030	.863	1.199	56	.236
SU-84	1.163	.286	1.878	56	.066
SU-85	.336	.565	2.448	56	.018
SU-86	.412	.523	1.480	56	.144
SU-87	1.547	.219	.591	56	.557
SU-88	.497	.484	.009	56	.993
SU-89	.025	.874	.202	56	.840
SU-90	.028	.867	1.205	56	.233
SU-91	.182	.672	1.350	56	.182
SU-92	4.553	.037	1.791	56	.079
SU-93	.446	.507	.596	56	.553
SU-94	3.126	.083	.578	56	.566
SU-95	1.542	.219	.082	56	.935
SU-96	.077	.782	.603	56	.549
SU-97	.004	.947	1.737	56	.088
SU-98	.355	.553	.433	56	.667
SU-99	.103	.749	1.738	56	.088

SU-100	.006	.938	1.058	56	.295
SU-101	.941	.336	.484	56	.631
SU-102	.002	.966	.573	56	.569
SU-103	.132	.718	.243	56	.809
SU-104	.002	.962	.434	56	.666
SU-105	.911	.344	1.260	56	.213
SU-106	.912	.344	1.139	56	.260
SU-107	.281	.598	1.661	56	.102
SU-108	.396	.532	2.955	56	.005
SU-109	1.516	.223	1.034	56	.306
SU-110	1.137	.291	2.472	56	.016
SU-111	.643	.426	.569	56	.572
SU-112	1.409	.240	.603	56	.549
SU-113	2.986	.089	.083	56	.934
SU-114	.179	.674	.770	56	.444
SU-115	.000	.996	.706	56	.483
SU-116	.106	.746	.130	56	.897
SU-117	.861	.357	1.564	56	.123
SU-118	.034	.855	.487	56	.628
SU-119	.001	.976	1.895	56	.063
SU-120	.327	.570	2.198	56	.032
SU-121	.683	.412	2.312	56	.024
SU-122	.199	.657	.775	56	.441
SU-123	.843	.363	1.069	56	.290
SU-124	.014	.905	.076	56	.940
SU-125	2.087	.154	.877	56	.384
SU-126	.872	.355	1.354	56	.181
SU-127	7.244	.009	.361	56	.719
SU-128	.033	.856	.364	56	.717
SU-129	.462	.499	1.030	56	.308
SU-130	.188	.666	.841	56	.404
SU-131	.403	.528	1.277	56	.207
SU-132	.403	.528	1.277	56	.207
SU-133	.130	.719	1.378	56	.174
SU-134	2.950	.091	.801	56	.427

SU-135	1.142	.290	1.094	56	.279
SU-136	.184	.670	.276	56	.783
SU-137	.342	.561	.630	56	.531
SU-138	1.051	.310	1.295	56	.201
SU-139	.586	.447	.586	56	.561
SU-140	8.991	.004	.518	56	.607
SU-141	.742	.393	2.093	56	.041
SU-142	2.847	.097	.491	56	.626
SU-143	.512	.477	1.529	56	.132
SU-144	3.671	.060	1.536	56	.130
SU-145	.005	.946	1.169	56	.247
SU-146	.026	.872	.734	56	.466
SU-147	.438	.511	.952	56	.345
SU-148	.012	.912	.956	56	.343
SU-149	.023	.880	1.259	56	.213
SU-150	.866	.356	.870	56	.388
SU-151	.685	.411	.167	56	.868
SU-152	.127	.723	.684	56	.497
SU-153	2.080	.155	.896	56	.374
SU-154	5.029	.029	.304	56	.762
SU-155	.743	.392	.675	56	.502
SU-156	.499	.483	.083	56	.934
SU-157	.513	.477	2.406	56	.019
SU-158	4.995	.029	.379	56	.706
SU-159	.131	.719	1.566	56	.123
SU-160	.356	.553	1.258	56	.214
SU-161	.477	.493	2.160	56	.035
SU-162	.563	.456	1.750	56	.086
SU-163	.804	.374	.041	56	.967
SU-164	1.137	.291	1.077	56	.286
SU-165	.396	.532	.553	56	.583
SU-166	.940	.336	.033	56	.974
SU-167	.329	.569	.404	56	.688
SU-168	.104	.748	1.895	56	.063
SU-169	.045	.833	.770	56	.445

SU-170	3.299	.075	1.233	56	.223
SU-171	.764	.386	.077	56	.939
SU-172	.003	.953	.620	56	.538
SU-173	.402	.529	.026	56	.979
SU-174	1.336	.253	.357	56	.722
SU-175	.183	.671	1.045	56	.301
SU-176	.627	.432	.403	56	.689
SU-177	2.210	.143	.152	56	.879
SU-178	2.622	.111	1.141	56	.259
SU-179	.001	.979	1.052	56	.298
SU-180	.018	.893	1.447	56	.154
SU-181	.000	.998	1.877	56	.066
SU-182	5.339	.025	.868	56	.389
SU-183	.014	.906	2.985	56	.004
SU-184	.427	.516	.117	56	.907
SU-185	.236	.629	1.574	56	.121
SU-186	.104	.748	1.459	56	.150
SU-187	1.624	.208	.901	56	.371
SU-188	.578	.450	.718	56	.476
SU-189	.057	.812	.243	56	.809
SU-190	1.253	.268	.093	55	.926
SU-191	2.163	.147	.233	56	.816
SU-192	.370	.546	1.650	56	.104

XII. Item wise interpretation of the results:

Table No	Description of Analysis	V.3: Interpretation results
04	Results for Tests of Normality for finding the research question No.01: Are the feed backs collected from the teachers for the identification of content gaps in the chemistry curriculum under WBCHSE, following the normality?	From the normality testing of data, the results obtained in the (Table No. 04) and also from the different plots related with the normality, it has been observed that the data were not obeying the normality. Hence the feedbacks collected from the chemistry teachers for the identification of content gaps in the chemistry curriculum under WBCHSE, are not following the normality. That's why chi square design was

		applied as the non-parametric tests for Hypothesis testing:
07	Results for Tests of Normality for finding the research question: Are the feed backs collected from the teachers for the identification of teaching gaps in the chemistry curriculum under WBCHSE, following the normality?	After analysis of data for normality testing, in the different types of plots as well as from the values of descriptive analysis (Table No. 07) it has been found that the P-value obtained for Kolmogorov-Smirnov tests and Shapiro Wipro test is greater than 0.05, hence the data were obeying normality. Hence the feedback obtained from the chemistry teachers for the identification of teaching gaps in the specific sub-units in the chemistry curriculum under WBCHSE, are following the normality. So t-test was selected as a parametric test for hypothesis testing no. H04 .
08	Results obtained from Item wise analysis for the percentage of weightage for content gaps in H.S. Curriculum under WBCHSE:	After analysis of overall contents for the percentage of gaps in overall units of chemistry curriculum, it has been found that overall percentage of gaps is 22.87 as mentioned in Table No.8 .
09	Unit wise chi-square analysis on 30 units of chemistry curriculum for Null Hypothesis No.01	From the calculated value of chi square , when the degrees of freedom(df) is 4 , the critical value of chi square at both 0.05 and 0.01 level of significance are 9.48 and 13.27 respectively. If we critically analyze the values of chi square mentioned in the table No. 09 , we see that for the values of chi square for all units exceed from the critical values of chi-square. So null hypothesis is rejected at the both level of significance Hence we can conclude that there is a significant difference between the expected learning units and the learning units actually present in chemistry curriculum under WBCHSE.
10	Summary of sub-unit wise result for t-Test on 192 sub units of chemistry curriculum.	The critical value of t at .05 and 0.01 level of significance are 1.671 & 2.390 respectively. After critical analysis of the t-value of every sub-units as mentioned in the Table No. 09 , it has been observed that the calculated t-value in some specific sub-units exceed from their critical value. Hence null hypothesis is rejected for these specific sub-units, i.e. There are significant difference present between the expected teaching strategies and applied teaching strategies in the specific subunits of the

		chemistry syllabus under the WBCHSE.
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XIII. Major Findings:

1. From the normality testing of feedbacks for the identification of gaps in contents and teaching methods, it has been found that for content gaps the collected feedbacks were not following normality but for teaching gaps the collected feedbacks follows the normality.
2. From the analysis of data from the feedback of the chemistry teachers, for the identification of content gaps between the existing and expected content in the prescribed syllabus under WBCHSE, it has been found that in the all units there is a significant gaps between the existing and expected content.
3. From the analysis of data from the feedback of the chemistry teachers, for the identification of teaching gaps between the applied and expected teaching strategies for the specific sub-units in the prescribed syllabus under WBCHSE at first all the 30 units were sub-divided into the 192 subunits, it has been found that in the selected sub- units as mentioned in the Table No.10. , There is a significant gaps between the applied and expected teaching strategies.

XIV. Limitations of study:

The following limitations for this study are mentioned below:

1. In this study, students were selected from only the Bengali medium schools affiliated to the WBCHSE and also the selected schools were not covered from the all districts under West Bengal.
2. Although the tools used in this study were constructed through a systematic procedure and also all the constructed tools were validated under the study design, further sophistication could be made for the more refinement of the tools used in the study.
3. The total number of collected sample for identification of content and teaching gaps, was not sufficient for proper justification about the gaps in content and teaching strategies.

XV: Suggestion for further studies:

This research work was confined to so many limitations like time constraints, selection of sample, incorporation of other desired variables, and lack of space for using sophisticated statistical techniques. The researcher suggests that it is appropriate to make the study a full-fledged one and also to generalize and findings to be more effective the following steps may be taken which are:

1. The sample may be collected from a wider range of population for involvement of different strata of the greater society like urban vs. rural and also male vs. female.
2. The study may be done on the students under different boards at (10+2) level in India.
3. The special attention should be given for the development and refinement of tools used in the study.

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