Exploring Some Research Gaps in Testing Pre-concepts of the Learners in Science Classrooms

[1]Rakesh Kumar

[1]ASSISTANT PROFESSOR, UNIVERSITY OF DELHI.
(rakesh.sam21@gmail.com)

[2]Himani Sharma

[2]Freelance Writer and Researcher

(himaniedu87@gmail.com)

[3]Karishma Sharma

[3]Freelance Writer and Researcher

(karishma.edn@gmail.com)

Abstract

In the present study the teachers have planned their classroom proceedings in a framework that allows for strengths of informal environments to be used in formal classroom settings. The study focuses on preservice teacher's natural dispositions towards "Tested Pre-concepts of the Learners". These are tested in terms of Teacher's Gender, Nature of School Management and School Type. In the study relevant graphs related to this focus have been drawn and interpreted. 'Statistical Descriptives' of the same have also been interpreted as part of the study. In conclusion, the study did not find any significant difference in pre-service teachers' response to "Tested Pre-concepts of the Learners" in terms of Teacher's Gender, Nature of School Management and School Type. Pre-concepts of the learners are important in the sense that the further concept development is based on it. If the pre-concepts of the learners remain unaddressed these may hamper the development of scientific concepts. This has the potential to derail the whole progression of the learner in the scientific realm. The teachers attempt to identify these are the precursors to addressing them in timely and effective manner. For the teachers to attempt identifying the pre-concepts they have to cultivate the dispositions to test their presence. The present study contributes to the understanding what factors may or may not influence the process.

Key Words: Informal learning environments in science, learning strands, Science Classrooms, Pre-service teacher education, Teacher's Gender, Nature of School Management, School Type, Testing Pre-concepts of the Learners

Introduction:

(Bell, Lewenstein, Shouse, & Feder, 2009) proposed a "strands of science learning" framework that articulates science-specific capabilities supported by informal environments. It builds on the framework developed for K-8 science learning in Taking Science to School (Duschl, Schweingruber, & Shouse, 2007) "That four-strand framework aligns tightly with the Strands 2 through 5. They have added two additional strands—Strands 1 and 6—which are of special value in informal learning environments. The six strands illustrate how schools

and informal environments can pursue complementary goals and serve as a conceptual tool for organizing and assessing science learning. The six interrelated aspects of science learning covered by the strands reflect the field's commitment to participation—in fact, they describe what participants do cognitively, socially, developmentally, and emotionally in these settings. Learners in informal environments:

Strand 1: Experience excitement, interest, and motivation to learn about phenomena in the natural and physical world.

Strand 2: Come to generate, understand, remember, and use concepts, explanations, arguments, models, and facts related to science.

Strand 3: Manipulate, test, explore, predict, question, observe, and make sense of the natural and physical world.

Strand 4: Reflect on science as a way of knowing; on processes, concepts, and institutions of science; and on their own process of learning about phenomena.

Strand 5: Participate in scientific activities and learning practices with others, using scientific language and tools.

Strand 6: Think about themselves as science learners and develop an identity as someone who knows about, uses, and sometimes contributes to science (Bell et al., 2009)".

Background

Amongst educationists there had been a talk about about how the teaching-learning processes be designed so as to make them more effective and learner friendly. Learning in informal environments has been explored outside the classroom settings. Informal environments inside the classroom settings are however less explored. There had been an innovative work of applying informal Learning Strands in Science Classrooms (Kumar, 2014n; Prabha, Jha, & Kumar, 2012; Prabha, Kumar, & Jha, 2013; Prabha & Kumar, 2014) formally with unit and lesson planning for teaching-learning science. In the process there had been attempts to develop theoretical context of Alternative Frameworks (Kumar, 2011, 2012c, 2015, 2013k, 2013g, 2013h, 2013n, 2013a, 2013i, 2014m, 2014k) and to undertake Concept specific researches (Kumar, 2013b) on Alternative Framework in Science on Magnets (Kumar, 2014r), Rain (Kumar, 2014q), Soil (Kumar, 2014h), Cells (Kumar, 2014u), Electric Current (Kumar, 2014c), Light (Kumar, 2014v), Blood (Kumar, 2014x), Food (Kumar, 2014e), Mirrors and Lenses (Kumar, 2014j), Universe (Kumar, 2014s), Plant Reproduction (Kumar, 2014p), Sources of Energy (Kumar, 2014b), Air (Kumar, 2014o), Force (Kumar, 2014i), Light (Kumar, 2014v) etc. This had been followed by further research on understanding Natural Dispositions of the engaged teachers in Classroom Context (Kumar, 2013a) and related Processes (Kumar, 2012b, 2012a, 2014d, 2014g, 2014l, 2014a, 2014f, 2014t, 2014n, 2015, 2013l, 2013e, 2013j, 2013d, 2013f, 2013m, 2013c, 2014w). During the above cited attempts there had been a research gap on the factors affecting Tested Pre-concepts of the Learners. The current study is an attempt to fill that gap.

Research Methodology

Research Questions

The following questions are focused on the three identified factors viz. Teacher's Gender, Nature of School Management and School Type.

1. How do we graphically represent preservice teacher's natural dispositions towards "Tested Pre-concepts of the Learners" in terms of the identified factors?
2. How do we interpret 'statistical descriptives' related to preservice teacher's natural dispositions towards "Tested Pre-concepts of the Learners" in terms of the identified factors?
3. What are the differences (if any) in preservice teacher's natural dispositions towards "Tested Pre-concepts of the Learners" in terms of the identified factors?

Research Objectives

The study has focused on the following objectives:

1. To draw and interpret relevant graphs related to preservice teacher's natural dispositions towards "Tested Pre-concepts of the Learners" in terms of the identified factors.
2. To interpret the 'statistical descriptives' related to preservice teacher's natural dispositions towards "Tested Pre-concepts of the Learners" in terms of the identified factors.
3. To locate the differences (if any) in preservice teacher's natural dispositions towards "Tested Pre-concepts of the Learners" in terms of the identified factors.

Methodology, sample and tools:

Methodology:

In order to probe these questions along with many more, the researcher developed a wide-ranging tool to discover various questions concerned with the teaching-learning progressions in the science classrooms. This tool was used for reflecting on the science classrooms of the sample described in the next section. The researchers used IBM-SPSS for exploring the data thus collected.

Sample

Total thirty-eight Pre-Service Science teachers participated from two B.Ed. colleges, each from University of Delhi and GGSIP University, Delhi. This confirmed participation of total 18 schools in which above Pre-Service teachers had their School Life Experience Program. These teachers had diverse graduation and post-graduation subjects. First College had 8 participants and second college had 30 participants. Feedback responses from 592 lessons delivered by these 30 pre-service science teachers were analyzed. Out of total 38 Pre-Service teachers, code numbers 1.01 to code number 1.30 were given to 30 Pre-service teachers from First College of Education and 8 Pre-Service teachers from Second College of Education received code numbers 2.01 to code number 2.08. Clearly, the sample is not a random sample but a purposive one. Although

no deliberate attempt was made for the sample to be homogeneous or representative, it got addressed in the process to some extent. This fact is visible in the different factors that had been described below. The science teachers belonged to different socio-economic backgrounds. The science learners belonged to different sorts of school settings. Therefore, we can say that different socio-economic backgrounds and diversity in teaching-learning settings has been represented largely in the sample.

The properties of different factors that had been studied in the sample are described below.

Gender				
		Value	Count	Percent
Standard Attributes	Label	Teacher's Gender		
	Type	String		
	Measurement	Nominal		
Valid Values	1	Male	7	23.3%
	2	Female	23	76.7%
	3	Others	0	0.0%

Management				
		Value	Count	Percent
Standard Attributes	Label	Nature of School Management		
	Type	String		
	Measurement	Nominal		
Valid Values	1	Government School	5	16.7%
	2	Government Aided School	3	10.0%
	3	Private School	21	70.0%
	4	Kendriya Vidyalaya	1	3.3%

School Type				
		Value	Count	Percent
Standard Attributes	Label	School Type		
	Type	String		
	Measurement	Nominal		
Valid Values	1	'Boys Only' School	0	0.0%
	2	'Girl's Only' School	4	13.3%
	3	Co-Ed School	26	86.7%

Tools for data collection

In the present study questionnaire prepared by the researcher was used. Observations and unstructured interviews triangulated the data. The questionnaire was designed in the form of self- appraisal consisting of both open ended and close ended questions that can be analyzed quantitatively and qualitatively both. The questionnaire designed for the purpose was collected. Field experts, and colleagues in the teacher education institutions validated the tool prepared. Some issues related to the vagueness of language formatting style etc. were resolved in the process. This increased the authenticity of the questionnaire.

Analysis of Data

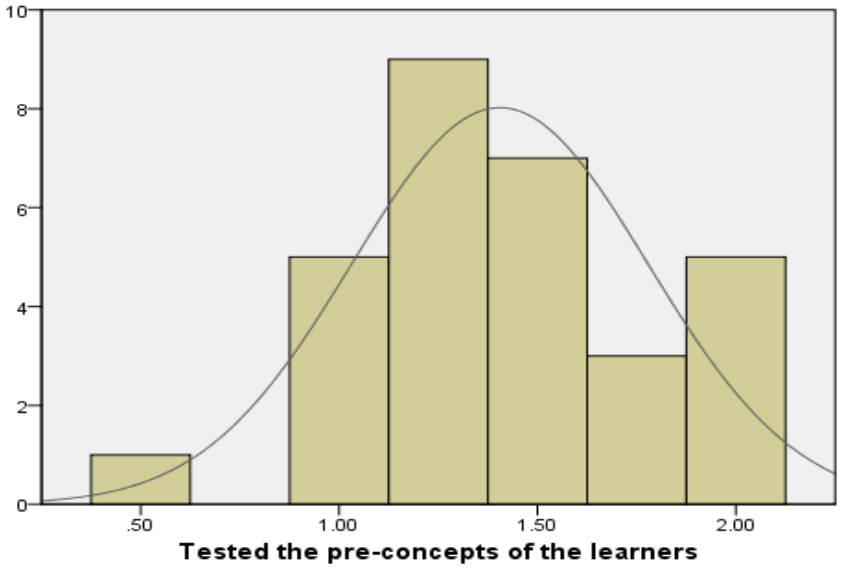
The schedule of self-assessment response, actually contained 26 items, and also had the choice of answering in terms of disagree, agree, and strongly agree. These three categories of choices are further given the marks of zero, one and two respectively. These responses in the form of marks of zero, one and two were provided as the feedback to the science teachers from the analysis. Also, these responses were then collected on the Microsoft Excel sheet for the duration of overall school time interaction program of all the participating pre-service science teachers. From this, the average score of one specific teacher was obtained. And the average scores of these 30 teachers were entered in separate Excel sheet for further analysis of their responses on the items in the questionnaire. One of the items from the Questionnaire was “Tested Pre-concepts of the Learners”. Graphs and descriptives from this item are being given in “findings” part of the study now.

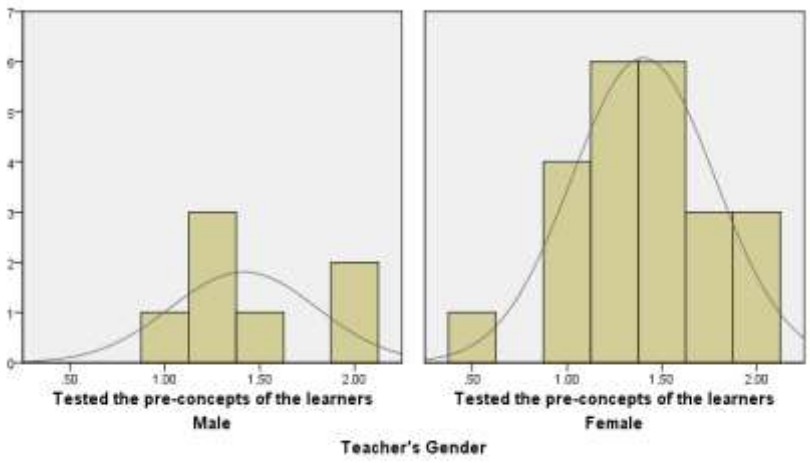
Findings

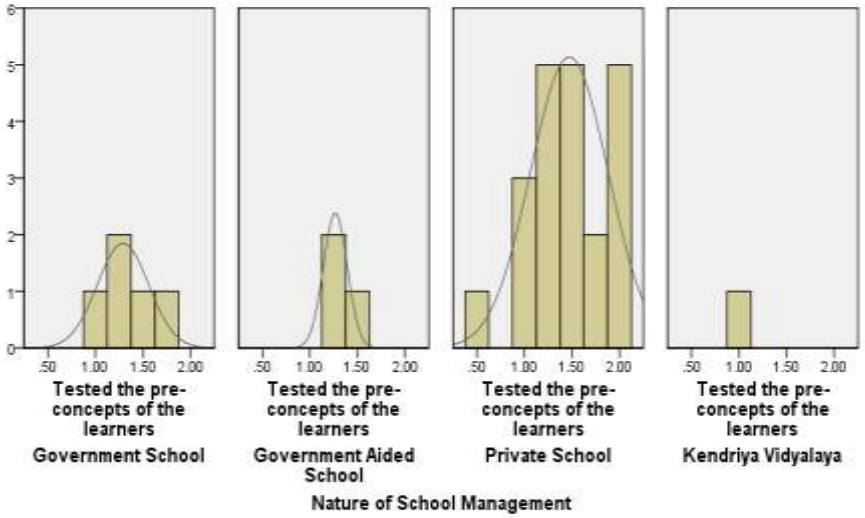
Table 1 shows the average scores of several teachers on the feedback schedule related to the Component “Tested Pre-concepts of the Learners” of the teaching-learning environment in damage of Teachers' Self-Assessment. The evaluation, interpretation and appropriate graphical descriptions had been used in the following discussions using the information from the Table 1.

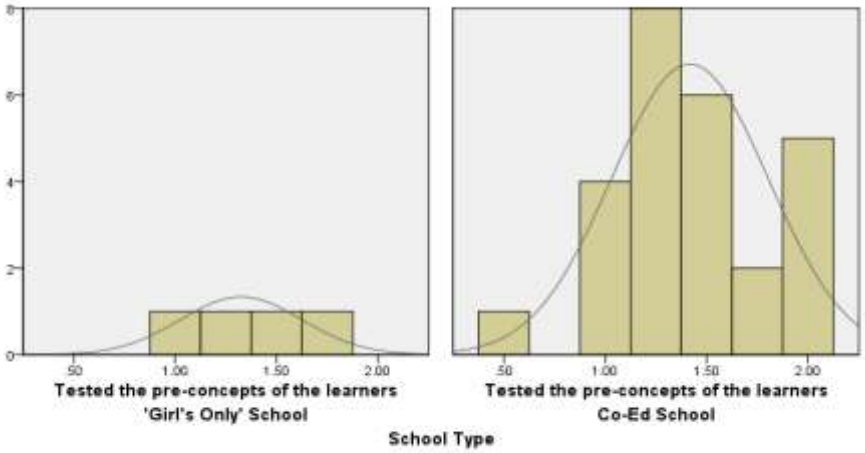
Table 1 - Individual average score of different respondents on the item: Tested Pre-concepts of the Learners

Tch. Cd.	Av. Score
1.03	1.2
1.09	1.4
1.14	1
1.22	2
1.27	1.25
1.28	1.9
2.01	1.15
1.01	1.05
1.02	1
1.04	1.85
1.05	1.5
1.06	1.95
1.07	1.6
1.08	1.8
1.1	1.15
1.11	1.55
1.12	1.25
1.13	1.7
1.17	1
1.18	1.95
1.19	1.55
1.2	1.2
1.21	1.95
1.23	1.6
1.24	1.35
1.25	1.2
1.26	1.4
1.3	1.15
2.02	1
2.03	0.5









Case Processing Summary

	Cases					
	Included		Excluded		Total	
	N	Percent	N	Percent	N	Percent
Tested the pre-concepts of the learners * Teacher's Gender	30	100.0%	0	0.0%	30	100.0%
Tested the pre-concepts of the learners * Nature of School Management	30	100.0%	0	0.0%	30	100.0%
Tested the pre-concepts of the learners * School Type	30	100.0%	0	0.0%	30	100.0%

Tested the pre-concepts of the learners * Teacher's Gender

Report								
Tested the pre-concepts of the learners								
Teacher's Gender	Mean	Median	Minimum	Maximum	Range	Std. Deviation	Skewness	Kurtosis
Male	1.4143	1.2500	1.00	2.00	1.00	.38591	.859	-.971
Female	1.4022	1.4000	.50	1.95	1.45	.37764	-.305	-.180
Total	1.4050	1.3750	.50	2.00	1.50	.37286	-.086	-.400

ANOVA Table							
			Sum of Squares	df	Mean Square	F	Sig.
Tested the pre-concepts of the learners * Teacher's Gender	Between Groups	(Combined)	.001	1	.001	.005	.942
	Within Groups		4.031	28	.144		
	Total		4.032	29			

Measures of Association		
	Eta	Eta Squared
Tested the pre-concepts of the learners * Teacher's Gender	.014	.000

Tested the pre-concepts of the learners * Nature of School Management

Report								
Tested the pre-concepts of the learners								
Nature of School Management	Mean	Median	Minimum	Maximum	Range	Std. Deviation	Skewness	Kurtosis
Government School	1.2900	1.2000	1.00	1.70	.70	.27019	.896	.427
Government Aided School	1.2667	1.2500	1.15	1.40	.25	.12583	.586	.
Private School	1.4714	1.5500	.50	2.00	1.50	.40791	-.518	-.223
Kendriya Vidyalaya	1.0000	1.0000	1.00	1.00	.00	.	.	.
Total	1.4050	1.3750	.50	2.00	1.50	.37286	-.086	-.400

ANOVA Table							
			Sum of Squares	df	Mean Square	F	Sig.
Tested the pre-concepts of the learners * Nature of School Management	Between Groups	(Combined)	.380	3	.127	.902	.453
	Within Groups		3.652	26	.140		
	Total		4.032	29			

Measures of Association		
	Eta	Eta Squared
Tested the pre-concepts of the learners * Nature of School Management	.307	.094

Tested the pre-concepts of the learners * School Type

Report								
Tested the pre-concepts of the learners								
School Type	Mean	Median	Minimum	Maximum	Range	Std. Deviation	Skewness	Kurtosis
'Girl's Only' School	1.3250	1.3000	1.00	1.70	.70	.29861	.423	-.416
Co-Ed School	1.4173	1.3750	.50	2.00	1.50	.38651	-.157	-.413
Total	1.4050	1.3750	.50	2.00	1.50	.37286	-.086	-.400

ANOVA Table						
			Sum of Squares	df	Mean Square	F	Sig.
Tested the pre-concepts of the learners * School Type	Between Groups	(Combined)	.030	1	.030	.207	.653
	Within Groups		4.002	28	.143		
	Total		4.032	29			

Measures of Association		
	Eta	Eta Squared
Tested the pre-concepts of the learners * School Type	.086	.007

Analysis and Interpretation:

1) The Mean is 1.405 which means on an average most teachers agree on Tested Pre-concepts of the Learners. The Median is 1.375 which means fifty percent of the cases lie above and below it. The Range for Total teachers taken together is 1.5 for which minimum value is 0.5 and maximum value is 2. This shows high difference between minimum and maximum values. This difference can be interpretated as high divergence in the mean scores on the response towards Tested Pre-concepts of the Learners. Standard deviation is 0.37286. S.D. when interpreted with the calculated means, it implies that most of the teachers scored between 1.03 and 1.77. This means, on an average most of the teachers agree on Tested Pre-concepts of the Learners and some strongly agree with it. Skewness is -0.086. which means that the data is slightly negatively skewed.

i.e., the number of low scorers is greater than the high scorers on the question of Tested Pre-concepts of the Learners. This is evident in the graphical representation of the data as well. Kurtosis is -0.4 which shows that the data distribution will be interpreted not outside the range of normality. This is evident in the graphical representation of the data as well.

2(a) The Mean is 1.4143 which means on an average most teachers agree on Tested Pre-concepts of the Learners. The Median is 1.25 which means fifty percent of the cases lie above and below it. The Range for Male teachers taken together is 1 for which minimum value is 1 and maximum value is 2. This shows high difference between minimum and maximum values. This difference can be interpretated as high divergence in the mean scores on the response towards Tested Pre-concepts of the Learners. Standard deviation is 0.38591. S.D. when interpreted with the calculated means, it implies that most of the teachers scored between 1.02 and 1.79. This means, on an average most of the teachers agree on Tested Pre-concepts of the Learners and some strongly agree with it. Skewness is 0.859. which means that the data is moderately positively skewed. i.e., the number of high scorers is greater than the low scorers on the question of Tested Pre-concepts of the Learners. This is evident in the graphical representation of the data as well. Kurtosis is -0.971 which shows that the data distribution will be interpreted not outside the range of normality. This is evident in the graphical representation of the data as well.

2(b) The Mean is 1.4022 which means on an average most teachers agree on Tested Pre-concepts of the Learners. The Median is 1.4 which means fifty percent of the cases lie above and below it. The Range for Female teachers taken together is 1.45 for which minimum value is 0.5 and maximum value is 1.95. This shows high difference between minimum and maximum values. This difference can be interpretated as high divergence in the mean scores on the response towards Tested Pre-concepts of the Learners. Standard deviation is 0.37764. S.D. when interpreted with the calculated means, it implies that most of the teachers scored between 1.02 and 1.77. This means, on an average most of the teachers agree on Tested Pre-concepts of the Learners and some strongly agree with it. Skewness is -0.305. which means that the data is slightly negatively skewed. i.e., the number of low scorers is greater than the high scorers on the question of Tested Pre-concepts of the Learners. This is evident in the graphical representation of the data as well. Kurtosis is -0.18 which shows that the data distribution will be interpreted not outside the range of normality. This is evident in the graphical representation of the data as well.

2(c) We test the null-hypothesis for the relation Tested Pre-concepts of the Learners * Teacher's Gender the value of the F-ratio comes out to be 0.005 and the p-value comes out to be 0.942 through ANOVA. The interpretation of the p-value reveals that it is more than the alpha level i.e., 0.05 which means that we retain the null hypothesis. The interpretation of the F-ratio reveals that it is less than the critical value 4.196 which means that we retain the null hypothesis. On the basis of this interpretation, we retain the null hypothesis for the relation Tested Pre-concepts of the Learners * Teacher's Gender as a conclusion of this interpretation. The value of eta-squared is 0 as shown in the table. As we retain the null-hypothesis the strength of association between Tested Pre-concepts of the Learners * Teacher's Gender is considered insignificant.

3(a) The Mean is 1.29 which means on an average most teachers agree on Tested Pre-concepts of the Learners. The Median is 1.2 which means fifty percent of the cases lie above and below it. The Range for Government School teachers taken together is 0.7 for which minimum value is 1 and maximum value is 1.7. This shows high difference between minimum and maximum values. This difference can be interpretated as high divergence in the mean scores on the response towards Tested Pre-concepts of the Learners. Standard deviation is 0.27019. S.D. when interpreted with the calculated means, it implies that most of the teachers scored between 1.02 and 1.56. This means, on an average most of the teachers agree on Tested Pre-concepts of the Learners and some strongly agree with it. Skewness is 0.896. which means that the data is moderately positively skewed. i.e., the number of high scorers is greater than the low scorers on the question of Tested Pre-concepts of the Learners. This is evident in the graphical representation of the data as well. Kurtosis is 0.427 which shows that the data distribution will be interpreted not outside the range of normality. This is evident in the graphical representation of the data as well.

3(b) The Mean is 1.2667 which means on an average most teachers agree on Tested Pre-concepts of the Learners. The Median is 1.25 which means fifty percent of the cases lie above and below it. The Range for Government Aided School teachers taken together is 0.25 for which minimum value is 1.15 and maximum value is 1.4. This shows low difference between minimum and maximum values. This difference can be interpretated as low divergence in the mean scores on the response towards Tested Pre-concepts of the Learners. Standard deviation is 0.12583. S.D. when interpreted with the calculated means, it implies that most of the teachers scored between 1.14 and 1.39. This means, on an average most of the teachers agree on Tested Pre-concepts of the Learners and some strongly agree with it. Skewness is 0.586. which means that the data is moderately positively skewed. i.e., the number of high scorers is greater than the low scorers on the question of Tested Pre-concepts of the Learners. This is evident in the graphical representation of the data as well. Kurtosis is incalculable. This is evident in the graphical representation of the data as well.

3(c) The Mean is 1.4714 which means on an average most teachers agree on Tested Pre-concepts of the Learners. The Median is 1.55 which means fifty percent of the cases lie above and below it. The Range for Private School teachers taken together is 1.5 for which minimum value is 0.5 and maximum value is 2. This shows high difference between minimum and maximum values. This difference can be interpretated as high divergence in the mean scores on the response towards Tested Pre-concepts of the Learners. Standard deviation is 0.40791. S.D. when interpreted with the calculated means, it implies that most of the teachers scored between 1.06 and 1.87. This means, on an average most of the teachers agree on Tested Pre-concepts of the Learners and some strongly agree with it. Skewness is -0.518. which means that the data is moderately negatively skewed. i.e., the number of low scorers is greater than the high scorers on the question of Tested Pre-concepts of the Learners. This is evident in the graphical representation of the data as well. Kurtosis is -0.223 which shows that the data distribution will be interpreted not outside the range of normality. This is evident in the graphical representation of the data as well.

3(d) The Mean is 1 which means on an average most teachers agree on Tested Pre-concepts of the Learners. The Median is 1 which means fifty percent of the cases lie above and below it. The Range for Kendriya

Vidyalaya teachers taken together is 0 for which minimum value is 1 and maximum value is 1. This shows no difference between minimum and maximum values. This difference can be interpreted as no divergence in the mean scores on the response towards Tested Pre-concepts of the Learners. Standard deviation is incalculable. Skewness is incalculable. Kurtosis is incalculable. This is evident in the graphical representation of the data as well.

3(e) We test the null-hypothesis for the relation Tested Pre-concepts of the Learners * Nature of School Management the value of the F-ratio comes out to be 0.902 and the p-value comes out to be 0.453 through ANOVA. The interpretation of the p-value reveals that it is more than the alpha level i.e., 0.05 which means that we retain the null hypothesis. The interpretation of the F-ratio reveals that it is less than the critical value 2.975 which means that we retain the null hypothesis. On the basis of this interpretation, we retain the null hypothesis for the relation Tested Pre-concepts of the Learners * Nature of School Management as a conclusion of this interpretation. The value of eta-squared is 0.904 as shown in the table. As we retain the null- hypothesis the strength of association between Tested Pre-concepts of the Learners * Nature of School Management is considered insignificant.

4(a) The Mean is 1.325 which means on an average most teachers agree on Tested Pre-concepts of the Learners. The Median is 1.3 which means fifty percent of the cases lie above and below it. The Range for 'Girl's Only' School teachers taken together is 0.7 for which minimum value is 1 and maximum value is 1.7. This shows high difference between minimum and maximum values. This difference can be interpreted as high divergence in the mean scores on the response towards Tested Pre-concepts of the Learners. Standard deviation is 0.29861. S.D. when interpreted with the calculated means, it implies that most of the teachers scored between 1.02 and 1.62. This means, on an average most of the teachers agree on Tested Pre-concepts of the Learners and some strongly agree with it. Skewness is 0.423. which means that the data is moderately positively skewed. i.e., the number of high scorers is greater than the low scorers on the question of Tested Pre-concepts of the Learners. This is evident in the graphical representation of the data as well. Kurtosis is -0.416 which shows that the data distribution will be interpreted not outside the range of normality. This is evident in the graphical representation of the data as well.

4(b) The Mean is 1.4173 which means on an average most teachers agree on Tested Pre-concepts of the Learners. The Median is 1.375 which means fifty percent of the cases lie above and below it. The Range for Co-Ed School teachers taken together is 1.5 for which minimum value is 0.5 and maximum value is 2. This shows high difference between minimum and maximum values. This difference can be interpreted as high divergence in the mean scores on the response towards Tested Pre-concepts of the Learners. Standard deviation is 0.38651. S.D. when interpreted with the calculated means, it implies that most of the teachers scored between 1.03 and 1.80. This means, on an average most of the teachers agree on Tested Pre-concepts of the Learners and some strongly agree with it. Skewness is -0.157. which means that the data is slightly negatively skewed. i.e., the number of low scorers is greater than the high scorers on the question of Tested Pre-concepts of the Learners. This is evident in the graphical representation of the data as well. Kurtosis is -

0.413 which shows that the data distribution will be interpreted not outside the range of normality. This is evident in the graphical representation of the data as well.

4(c) We test the null-hypothesis for the relation Tested Pre-concepts of the Learners * School Type the value of the F-ratio comes out to be 0.207 and the p-value comes out to be 0.653 through ANOVA. The interpretation of the p-value reveals that it is more than the alpha level i.e., 0.05 which means that we retain the null hypothesis. The interpretation of the F-ratio reveals that it is less than the critical value 4.196 which means that we retain the null hypothesis. On the basis of this interpretation, we retain the null hypothesis for the relation Tested Pre-concepts of the Learners * School Type as a conclusion of this interpretation. The value of eta-squared is 0.007 as shown in the table. As we retain the null-hypothesis the strength of association between Tested Pre-concepts of the Learners * School Type is considered insignificant.

Conclusion:

Pre-concepts of the learners are important in the sense that the further concept development is based on it. If the pre-concepts of the learners remain unaddressed these may hamper the development of scientific concepts. This has the potential to derail the whole progression of the learner in the scientific realm. The teachers attempt to identify these are the precursors to addressing them in timely and effective manner. For the teachers to attempt identifying the pre-concepts they have to cultivate the dispositions to test their presence. The study focuses on preservice teacher's natural dispositions towards "Tested Pre-concepts of the Learners" in terms of Teacher's Gender, Nature of School Management and School Type. In the study relevant graphs related to this focus have been drawn and interpreted. 'Statistical Descriptives' of the same have also been interpreted as part of the study. The study did not find any significant difference in pre-service teachers' response to "Tested Pre-concepts of the Learners" in terms of Teacher's Gender, Nature of School Management and School Type.

References:

- Bell, P., Lewenstein, B., Shouse, A. W., & Feder, M. A. (2009). *Learning Science in Informal Environments: People, Places, and Pursuits*. Washington, D.C.: THE NATIONAL ACADEMIES PRESS.
- Duschl, R. A., Schweingruber, H. A., & Shouse, A. W. (2007). Taking Science to School: Learning and Teaching Science in Grades K-8. In R. A. Duschl, H. A. Schweingruber, & A. W. Shouse (Eds.), *Taking Science to School*. Washington, D.C.: THE NATIONAL ACADEMIES PRESS.
- Kumar, R. (2011). Development of Alternative Frameworks Among Learners in Science: A Reflection on the Learning Theories and Models. *Journal of Teacher Education in Developing Nations (2229-4694)*, *2*(2), 55–61.
- Kumar, R. (2012a). A Study of Intending Teachers' Organisation of the Content and Processes of the Science Lesson. *Indian Journal of Experimentation and Innovation in Education (ISSN 2278-1730)*, *1*(3).

- Kumar, R. (2012b). Encouraging Enquiry Approach in the Learners. *Indian Journal of Experimentation and Innovation in Education (ISSN 2278-1730), 1*(6).
- Kumar, R. (2012c). Nature of Science, Science Assessment and Constructivist Epistemology: An Attempt to Decode the Hidden Mysteries. *Indian Journal of Experimentation and Innovation in Education (ISSN 2278-1730), 1*(1).
- Kumar, R. (2013a). Addressing the Alternative Frameworks Amongst Learners: A Study of Classroom Context. *Indian Journal of Experimentation and Innovation in Education (ISSN 2278-1730), 2*(6).
- Kumar, R. (2013b). An Analysis of Concept Specific Researches in the Formation of Alternative Frameworks. *Indian Journal of Experimentation and Innovation in Education (ISSN 2278-1730), 2*(6).
- Kumar, R. (2013c). An Analysis of Pre Service Teachers' Natural Disposition For Posing Interpretative Questions to the Learners in Science. *Indian Journal of Experimentation and Innovation in Education, 2*(5).
- Kumar, R. (2013d). Analysis of Pre Service Teachers' Natural Disposition for Testing Pre-Concepts amongst Learners in Science: An Indian Context. *Indian Journal of Experimentation and Innovation in Education (ISSN 2278-1730), 2*(6).
- Kumar, R. (2013e). Attempting to take Learners Along in Conducting Classroom Activities. *Indian Journal of Experimentation and Innovation in Education (ISSN 2278-1730), 2*(3).
- Kumar, R. (2013f). Carefully Designing the Science Activities Appropriate for the Group. *Indian Journal of Experimentation and Innovation in Education (ISSN 2278-1730), 2*(1).
- Kumar, R. (2013g). Constructing a Theoretical Framework on Alternative Frameworks Amongst Learners in Science. *Indian Journal of Education Research Experimentation and Innovation (ISSN 2231-0495), 3*(4).
- Kumar, R. (2013h). Differentiating 'Scientific Concepts'' from "OTHER'' Concepts: An Analytico-Deductive Approach."' *Indian Journal of Education Research Experimentation and Innovation (ISSN-22310495), 3*(5). https://doi.org/10.1080/0950069900120507
- Kumar, R. (2013i). Encouraging Collaborative Learning Environment in Science Classroom. *Indian Journal of Education Research Experimentation and Innovation (ISSN 2231-0495), 3*(2).
- Kumar, R. (2013j). Gauging Teachers' Tolerance towards Individual Interpretations by the Learners. *Indian Journal of Experimentation and Innovation in Education (ISSN 2278-1730), 2*(5).
- Kumar, R. (2013k). Identifying Design Features of Science Learning Environment: An Extrapolation of Learning Theories, Models and Ideas. *Indian Journal of Education Research Experimentation and Innovation (ISSN 2231-0495), 3*(3).
- Kumar, R. (2013l). Motivating Non-Participating Learners in Classroom. *Indian Journal of Experimentation and Innovation in Education (ISSN 2278-1730), 2*(4), 1–8.
- Kumar, R. (2013m). Preconceived Notion of Expected Answer and Teaching-Learning Contexts: An Analysis. *Indian Journal of Education Research Experimentation and Innovation (ISSN 2231-0495), 3*(5).
- Kumar, R. (2013n). Probing the Interplay of Nature of Science with Culture of Science in the Formation

of Alternative Frameworks. *Indian Journal of Experimentation And Innovation in Education (ISSN 2278-1730), 2*(5).

- Kumar, R. (2014a). Analysing Learners' Reactions and Responses: Study of an Indian Science Classroom Context. *Indian Journal of Experimentation and Innovation in Education (ISSN 2278-1730), 3*(3).
- Kumar, R. (2014b). Conceptions, "Other Conceptions" and their sites: Specific case of studying "Sources of Energy." *Indian Journal of Experimentation and Innovation in Education (ISSN 2278-1730), 3*(6).
- Kumar, R. (2014c). Context of Forming Concepts and 'Other Concepts'': "Electric Current'' as a Theme of Weaving Linkages."' *Indian Journal of Experimentation and Innovation in Education (ISSN 2278-1730), 3*(2).
- Kumar, R. (2014d). Culture of Science and Scaffolding: A Study of Teachers' Focus on Learners' Individual Explorations. *Indian Journal of Education Research Experimentation and Innovation (ISSN 2231-0495), 4*(1).
- Kumar, R. (2014e). Formation of Conceptions and 'Other Conceptions'' Related to "Food''."' *Indian Journal of Experimentation and Innovation in Education (ISSN 2278-1730), 3*(3).
- Kumar, R. (2014f). Giving Space to Children's Voices, Experiences and Needs: An Analysis of Pre-service Teachers' Natural Dispositions. *Indian Journal of Education Research Experimentation and Innovation (ISSN 2231-0495), 4*(2).
- Kumar, R. (2014g). Learners' adequacy in using Computer Assisted Learning in the Classroom. *Indian Journal of Education Research Experimentation and Innovation (ISSN 2231-0495), 4*(6).
- Kumar, R. (2014h). Learners' Ideas on 'Soil'' and Classroom Implications.' *Indian Journal of Education Research Experimentation and Innovation (ISSN 2231-0495), 4*(6).
- Kumar, R. (2014i). Learners and Their Concepts of 'Force''.' *Indian Journal of Education Research Experimentation and Innovation (ISSN 2231-0495), 4*(4).
- Kumar, R. (2014j). 'Mirrors and Lenses'': Concept and Conceptual Change in Indian Science Classroom.' *Indian Journal of Education Research Experimentation and Innovation (ISSN-22310495), 4*(5).
- Kumar, R. (2014k). Need and Significance of Exploring Alternative Frameworks Amongst Learners in Science. *International Journal of Innovative Education (ISSN 2393-8404), 1*(3).
- Kumar, R. (2014l). Practicing Culture of Science by Encouraging Learners' Attempt to Generate Solutions to Problems. *International Journal of Innovative Education (ISSN 2393-8404), 1*(2).
- Kumar, R. (2014m). Pre-service Teachers Notions about Alternative Frameworks/Misconceptions Amongst Learners in Science. *Indian Journal of Experimentation and Innovation in Education (ISSN 2278-1730), 3*(6).
- Kumar, R. (2014n). Scaffolding Learners to Generate Explanations, Arguments and Models: Taking Indication from Learning Strands Framework. *International Journal of Innovative Education (2393-8404), 1*(1).

- Kumar, R. (2014o). Science Learning Contexts and Network of Conceptions in Reference to the Topic – AIR. *Indian Journal of Education Research Experimentation and Innovation (ISSN 2231-0495), 4*(2).
- Kumar, R. (2014p). Strategies for Identifying Conceptions and 'Other Conceptions' Related to 'Plant Reproduction.' *Indian Journal of Experimentation and Innovation in Education (ISSN 2278-1730), 3*(5).
- Kumar, R. (2014q). Study of Learners' Alternative Frameworks Related to 'Rain''.' *International Journal of Innovative Education (ISSN 2393-8404), 1*(5).
- Kumar, R. (2014r). Studying Learners Alternative Frameworks on 'Magnets.' *International Journal of Innovative Education (ISSN 2393-8404), 1*(4).
- Kumar, R. (2014s). Studying the Science Learning Contexts While the Topic / Area of Explorations was 'UNIVERSE.' *Indian Journal of Education Research Experimentation and Innovation (ISSN 2231-0495), 4*(4).
- Kumar, R. (2014t). Teachers' Dispositions to Assist Learners in Metacognitive Processes. *Indian Journal of Experimentation and Innovation in Education (ISSN 2278 -1730), 3*(1).
- Kumar, R. (2014u). Understanding Classroom Settings in Indian Context While Topic 'Cells'' is Taken-Up in Class.' *Indian Journal of Education Research Experimentation and Innovation (ISSN 2231-0495), 4*(3).
- Kumar, R. (2014v). Understanding Teaching-Learning Context in Developing Students' Ideas on 'Light''.' *International Journal of Innovative Education (ISSN 2393-8404), 1*(3).
- Kumar, R. (2014w). Validating Language by Modifying the Language as Per Learners' Needs: An Analysis of Science Classroom Context. *Indian Journal of Education Research Experimentation and Innovation (ISSN 2231-0495), 4*(3).
- Kumar, R. (2014x). What are Learners' Thinking While the Topic "Blood" is Undertaken in the Class? *International Journal of Innovative Education (ISSN 2393-8404), 1*(2).
- Kumar, R. (2015). Accommodating Teachers' Encounters and Learners' Speculations Related to Alternative Frameworks in Science. *International Journal of Innovative Education (ISSN 2393-8404), 2*(1).
- Prabha, S., Jha, A. K., & Kumar, R. (2012). Efficacy of Learning Strands in Science Education: Implications for Pre-service Teachers and Teaching in India. *Canada International Conference on Education-2012*, 157–162.
- Prabha, S., & Kumar, R. (2014). Prospective Science Teachers' Reflections on the Use of Learning Strands in Developing Lesson Design. *European Scientific Journal September 2014 /SPECIAL/, 1*, 121–131. Portugal.
- Prabha, S., Kumar, R., & Jha, A. K. (2013). Learning Strands: Empowering Prospective Teachers for Science Practices in Indian Context. *International Journal for Cross-Disciplinary Subjects in Education (IJCDSE), 4*(3), 1205–1212.