Effect Of Teaching Strategies On Class IX Level Learners' Academic Achievement In Physical Science At Pingla Block

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Abstract:

In education psychology, classroom instructional techniques or teaching strategies are the most important factors that impacts on the learners' academic achievement in now a days. To make a meaningful learning experiences throughout the classroom sessions it is very much essential to improve teaching-learning process continuously. In 1968 David Paul Ausubel had proposed the meaningful verbal learning theory that supports the teaching-learning processes very effectively. In case of meaningful concept formation in science learning, concept mapping teaching strategy, an example of democratic teaching strategy plays a significant role rather than the demonstration teaching strategy, an example of autocratic teaching strategy. Hence, the objective of this present study was to investigate that how far the teaching strategies have some significant effect on the learners' academic achievement in case of physical science learning in the daily classroom sessions. Randomized Solomon four equivalent groups design was applied by the researcher. Total sample of the study was 152. Two Bengali medium co-ed schools at Pingla block of Kharagpur Subdivision of Paschim Medinipur district in West Bengal were selected purposively as target sample for this study. Then all the class IX level students of these two schools were selected as accessible sample in this study. Bengali version of the tool of "Mixed type group test of intelligence (MGTI)" (originally developed in English version by Dr. P.N. Mehrotra, 2008), which is modified by the researcher, was administered here for preparing the matched group i.e., experimental group (taught through concept mapping teaching strategy) and controlled group (taught through demonstration teaching strategy). A self-made achievement test tool which is based on the selected class IX physical science unit of W.B.B.S.E. was used here for data collection. All the collected data were analyzed by the help of descriptive statistics, inferential statistics like "t" test, ANOVA etc. Excel and SPSS software techniques were used here. It is shown in the result that there was a significant deference present in gain score ($p<0.05$) of learners' academic achievement in physical science of class IX level students of

Experimental (E) and Control group (C1) taught through concept mapping teaching strategy and demonstration teaching strategy respectively.

Key Words: Teaching Strategy, Academic Achievement, Physical Science.

I. INTRODUCTION

In the last decade, it is seen that there is a change in the mode of instruction of learning a child. Learning a child means that there will be an instructor who gives the instruction or direction the child properly to channelize him/her in the right way. At the stage of secondary level school education it is the crucial period for constructing knowledge by the students' own self. Hence, at this time we have to think about the change of our perception about the teaching learning process that educating a child should be learning without burden. And we have to follow this motto of learning by creating the classroom sessions containing more fun, creative, collaborative and exploratory activities. NEP – 2020 also emphasizes this. That's why a democratic teaching strategy is to follow in the classroom session. Concept mapping teaching strategy is a technique for externalizing the ideas, concepts and propositions of teaching-learning process (Novak, 1979). It is an example of democratic teaching strategy that can facilitates and enhances students' cognition level by connecting a link between the previous and present experiences. In case of science education formation of this link is very much important for knowledge construction. Students' academic achievement depends upon this.

Background of the Study:

David Paul Ausubel (1968) said that -"Learning is not only the acquisition of new concepts but the construction of meaningful link among concepts". According to him a learner absorbs new information by correlating it to its previous experiences that they have already acquired. A mind game is always run in the learners' mind at the time of building connection between preexisting concepts and ideas and the newly acquired knowledge. In this circumstances a proper teaching-learning process can successfully build up this connection to make a meaningful experience. Ausubel's (1968) "meaningful verbal learning theory" also supports this idea. On the basis of Ausubel's meaningful learning theory, Prof. J. D. Novak and his colleagues at Cornell University has developed Concept Mapping, a democratic teaching-learning strategy for externalizing concepts and propositions (Novak, 1979). Learners' academic achievement is tying strongly with the democratic teaching strategies. NCF – 2005 also emphasizes this strategy for achieving the goal of acquisition of learning. From this point of view this study plays a significant role on pedagogical shifting from autocratic teaching strategy to democratic teaching strategy of teaching-learning process.

Literature Review of the Study:

After reviewing all the Indian and outside Indian literatures related to this study, it is shown that learners taught through concept mapping teaching strategy improves their academic achievement over the other conventional teaching strategy. Same findings has been seen in the following studies, such as – Emmanuel (2013); Jack (2013); ALshammari (2015); Nwoke, Iwu & Uzoma (2015); Sakiyo & Waziri (2015); Filgona et al. (2016); Martins-Omole, Yusuf & Guga (2016); Shakoori, Kadivar & Sarami (2017); Shamsuddin et al. (2017); etc. Researchers are also seen that some studies has been conducted on the relation between the learning strategy of students and their achievement in various subjects. These are – Vrugt & Oort (2008); Stel & Veenman (2008); Sharma, Harsana & Sharma (2013); Aziz & Rahman (2014); Chawla (2015); etc. Collaborative learning: shown by - Gaitonde, Tembe & Kamble (2017); attitude towards study: shown by – Alebiosu & Michael (2011); interest on study: shown by – Chiou (2008) - all are linked with the concept mapping teaching strategy. But a very few study is likely to be seen in India as well as in West Bengal about the effect of teaching strategies on secondary level learners' academic Achievement in Physical Science subject.

Significance of the Study:

Science classroom is based on activity oriented sessions. In this session hands on experiments, creative thinking, collaborative and problem solving oriented activities are to be nurtured properly. That's why students' attitude, motivation and interest towards science subject are grown up. But it is shown frequently that autocratic teaching strategy i.e.; teacher-centered approach is applied in maximum cases for giving instruction in the science class. As a consequent result of this it is shown that students are felt to achieve their satisfactory result in science and gradually their interest towards science decreases.

But concept mapping teaching strategy, an example of democratic teaching strategy is used for externalizing concepts and propositions. It was developed by Novak and his colleagues at Cornell University in 1970s. At first this strategy was significantly used to know the changes in learners' understanding level of science concepts. Now, it is generally used to help learners for constructing their knowledge to achieve better result. Hence, this teaching strategy has been evolved into a multifaceted tool in education (Novak, 1990a; Admaczyk, Wilson & Willams, 1994; Jonassen et al., 1997). "Due to various applications of concept mapping as an instructional tool, an assessment tool, a learning tool, a meta-cognitive strategy, hence it has a significant role on empowering learners to monitor and control cognitive progress" (Jegede, Alaiymola & Okebukola, 1990; Trowbridge & Wandersee, 1994).

In the present study, researchers are tried to investigate that how far teaching strategy effects on the class IX level learners' knowledge acquisition in physical science subject.

Statement of the Problem:

To make a child academically sound and getting better achievement in all subjects at secondary level, it is very much essential to construct knowledge meaningfully by own self. Different teaching strategies are present to enhance learner's academic achievement in science. Thus the present study is an attempt to investigate the - "**Effect Of Teaching Strategies On Class IX Level Learners' Academic Achievement In Physical Science At Pingla Block**".

Operational Definition of the Key Terms:

1. **Teaching Strategy**

Teaching Strategy refers to such a style or pattern of teaching activities that serves to attain certain learning outcomes at the end of the instruction. Here investigators have used two types of teaching strategies in their study - one is Demonstration teaching strategy, i.e.; autocratic teaching strategy and other one is concept mapping teaching strategy, i.e.; democratic teaching strategy. Selected unit of class IX physical science text book is taught through these strategies.

2. **Academic Achievement**

In this study academic achievement refers to the performance of class IX students in terms of scores obtained in physical science subject.

3. **Physical Science**

"Physical science"- term comes from the title of the class IX syllabus of West Bengal Board of Secondary education. It includes both the study of various physics and chemistry concepts.

Objective of the Study:

O1: To compare the effect of concept mapping strategy and demonstration strategy of teaching on learners' academic achievement in physical science at secondary level.

Hypothesis of the Study:

$H_0$1: There is no significant difference between gain score of learners' academic achievement in physical science taught through concept mapping strategy and demonstration strategy at secondary level.

Delimitations of the Study:

The study had following delimitations:

    i.   Present study was delimited to class - IX students of West Bengal Board of Secondary Education (W.B.B.S.E.) Bengali medium Co-Ed School only.

    ii.   Sample of the study was delimited to 152 students only.

II. METHODOLOGY

Method of the Study:

Quantitative research method was applied here for data collecting and analyzing purpose.

Research Design:

True experimental research design of Randomized Solomon four equivalent groups design was applied in this study.

Population and sample of the Study:

Researchers were selected all the Bengali Medium Schools situated at the Kharagpur subdivision of Paschim Medinipur district in West Bengal under the West Bengal Board of Secondary Education as accessible population for this study.

From this accessible population, all the class IX students of two purposively selected Bengali Medium Secondary Co-Ed Schools at Pingla Block in Paschim Medinipur District of West Bengal State in India named as School 1: Upalda Sarboday Madhyamik Sikshaniketan (H.S.) and School 2: Gobardhanpur Pramathanath Vidyayatan were the sample in this study.

Sample Details:

After the completion of all the data normalization and exploration process each school of 76 number of class IX students were selected by the researcher as a target sample. Thus the total sample was 152. In the following table 1 sample structure is shown in detail:

Table 1:

Name of School × Type of Group × Teaching Strategy Cross tabulation

Name of School	Type of Group	Teaching Strategy		Total
		Concept Mapping (CM)	Demonstration (DM)	
School 1: Upalda Sarboday Madhyamik Sikshaniketan (H.S.)	Experimental (E) – Pre-tested (CM)	38	0	38
School 2: Gobardhanpur Pramathanath Vidyayatan	Control (C1) – Pre-tested (DM)	0	38	38
School 1: Upalda Sarboday Madhyamik Sikshaniketan (H.S.)	Control (C2) – Not Pre-tested (CM)	38	0	38
School 2: Gobardhanpur Pramathanath Vidyayatan	Control (C3) – Not Pre-tested (DM)	0	38	38
	Total	76	76	152

Variables of the study:

In this study, researcher were used Teaching Strategy (i.e. - Teaching through Concept Mapping Strategy and Demonstration Strategy) as an independent variable and class IX level Learners' Academic achievement in Physical Science as a dependent variable. Learners' intelligence level was used here as an example of moderator variable. Boredom, fatigue, excitement, anxiety of the students etc. are the example of intervening variables. These variables are beyond the control of the investigator and that's why it remains uncontrolled throughout process of the experimentation.

Tools used for the Study:

In the present study investigator had used two types of tools. These were – 1) Measuring Tool, i.e.; a) Bengali version of the 'Mixed Group Intelligence Test (MGTI)' of Mehrotra (2008) for measuring intelligence of students and also for the formation of the matched group, b) Self-made Academic Achievement test based on the instructional objectives of Revised Bloom's Taxonomy; and 2) Instructional Tool, i.e.; a) Unit wise lesson plan based on the both teaching strategies, and b) Teaching-learning materials.

Procedure of Data Collection:

At first Bengali version of Mixed Group Intelligence Test (MGTI) was administered by the researcher to the selected class – IX students of the target schools. According to their intelligence test score a matched group in between the School 1 (match group A) & School 2 (match group B) was prepared. Then again these two matched groups (A & B) were divided into another two halves on the basis of their previous intelligence test score. Thus the Solomon four equivalent randomized groups were prepared. After that the intervention was started and the group A was taught through concept mapping strategy and group B was taught through demonstration strategy. Pre-test (T1) and post-test (T2) result of learners' academic achievement in selected physical science unit were reported in due time. After the completion of data normalization and exploration process 152 samples were finalized by the researchers for analyzing the data quantitatively.

Procedure of Data Analysis:

For quantitative data analysis researchers were used descriptive statistics and also inferential statistics like "t" test and ANOVA for finding out the results and inferences.

III. DATA ANALYSIS AND INTERPRETATION

Software & Techniques used for this Study:

Excel and SPSS software techniques were applied by the researcher for tabulation and analyze the data. Statistical techniques like Mean, Variance, Standard Deviation, Standard Error of Mean, t-test, ANOVA etc. were applied in this study.

Objective wise Analysis and Interpretation of Result:

Objective 1

O1: To compare the effect of concept mapping strategy and demonstration strategy of teaching on learners' academic achievement in physical science at secondary level.

Hypothesis 1

$H_0 1$: There is no significant difference between gain score of learners' academic achievement in physical science taught through concept mapping strategy and demonstration strategy at secondary level.

To investigate the significant difference between gain score of learners' academic achievement in physical science of the experimental and control group of pre-tested and post-tested group taught through Concept mapping and Demonstration teaching strategy, descriptive statistics and t-test were applied between mean gain scores of students of Experimental group and Controlled group.

Results

For testing the hypothesis 1 (H_o1), firstly researcher had decided to analyze the descriptive statistics of Gain (Post Test-Pre Test) Achievement of experimental group (E) and control group (C1) in physical science taught through Concept Mapping and Demonstration teaching strategy respectively. The values are given in table 2. On the basis of this descriptive statistics, t- test was performed. This is shown in table 3 below.

T-Test: Type of Test Group = Pre-Tested

Table 2:

Group Statistics

Deference between the Test	Test Group	Teaching Strategy	N	Mean	Std. Deviation	Std. Error Mean
Gain (Post Test-Pre Test) = Gain Achievement	Experimental Group (E)	Concept Mapping (CM)	38	13.408	5.9682	0.9682
	Control Group (C1)	Demonstration (DM)	38	8.934	6.9469	1.1269

Table 3:

Independent Samples Test

Deference between the Test	Variance nature	Levene's Test for Equality of Variances		t-test for Equality of Means							
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Gain (Post Test-Pre Test) = Gain Achievement	Equal variances assumed	0.015	0.902	3.011[*]	74	**0.004**	4.4737	1.4857	1.5133	7.4340

Note. ***** t is significant at 5% level of significance.

Interpretation

Table 2 reveals that Group Statistics of gain score in academic achievement in physical science of post-tested (T2) and pre-tested (T1) experimental (E) and control group (C1) taught through concept mapping and demonstration strategy. It shows that mean gain (Post Test-Pre Test) score of academic achievement in concept mapping and demonstration teaching strategies are 13.408 and 8.934 respectively. Standard deviations are 5.9682 and 6.9469 respectively. Standard Error of Mean are 0.9682 and 1.1269 respectively.

Table 3 shows the independent samples test. Sig. value of Levene's Test for Equality of Variances shows 0.902, which is not significant at 0.05 level of significance (i.e, $p>0.05$). It indicates that the two groups have equal variances. Hence, the statistics associated with equal variances assumed was used here for the t-test for Equality of Means. The t-test result shows that the Sig. (2-tailed) value is 0.004, which is less than 0.05 (i.e., $p<0.05$). Hence, t is significant. Therefore the null hypothesis is rejected at 5 % level of significance. Thus, it is concluded that significant deference present in gain score of academic achievement in physical science of Experimental (E) and Control group (C1).

Major Finding:

On the basis of the results and their interpretations researcher concludes some findings. The major finding is as follows:

- There is a significant difference present between the gain score of learners' academic achievement in physical science of Experimental (E) & Control group (C1) taught through concept mapping strategy and demonstration strategy respectively at secondary level.

Discussions of the Result:

Finding of this study indicates that concept mapping teaching strategy has a significant effect on the class IX level learners' academic achievement in physical science over the demonstration strategy. Same findings have been seen in the following studies, such as - Jena (2012), Sharma, Harsana & Sharma (2013), Aziz & Rahman (2014), Chawla (2015), Chawla & Singh (2015), etc. Researcher has observed that a number of reasons are responsible for these finding. These are – 1) Learners' long term memory enhances through this concept mapping teaching strategy. Novak & Musonda (1952) said that it should takes a long time to familiar with this kind of teaching strategy for making a meaningful learning process. That's why the present researcher had carried on their intervention for more than three months. 2) It also helps students to promote meaningful learning in case of achieving better result in science. Studies of Parsa & Nikbakht (2004), Chiou (2008) etc. also supports this kind of findings.

Educational Implications:

Now a days the educational implications of concept mapping teaching strategy in case of learning in various field of science are very much impressive than the other autocratic teaching strategy. Hence, it needs to be explored and nurtured in our school environment as they are of various use for learners, teachers, curriculum developers and evaluators (cited in Pedagogy of Science, Textbook For B.Ed. Part - I, N.C.E.R.T., 2013, p. 233). Some important educational implications of concept mapping teaching strategy are – 1) Learners can construct their knowledge significantly by the help of this, 2) Learners can make better sense with the help of this strategy in case of understanding new concepts, 3) It also helps learners to understand complex materials easily, 4) It helps learners to identify easily their knowledge gaps. 5) It significantly helps instructors to identify learner's misconceptions at the time of their learning process is going on.

Limitations of the Study:

The study has following limitations, such as – 1) Absenteeism at the time of intervention process is a vital limitation of this study. 2) It will give a better result if this study will be conduct in the residential schools. 3) If it is possible to store the whole intervention process in videography mode then it will be better to interpret the result properly.

Conclusion:

After considering all the reviews, analysis, interpretations, findings and discussions, investigators have come to the point that concept mapping teaching strategy is an effective teaching strategy rather than demonstration teaching strategy in case of class IX standard learners' academic achievement. It very much helps the learner to achieve better in their meaningful learning. The original meaning of science learning can be satisfies until a proper teaching-learning strategy is to be selected. Construction of knowledge through concept map formation i.e., learning through hands on activities in science can make a child's future brighter.

References:

Adamczyk, P., Wilson, M., and Williams, D. (1994). Concept mapping: a multi-level and multi- purpose   tool. *School Science Review*, *76*, 116-124.

Alebiosu, K., and Michael, E. (2011). Concept Mapping Teaching Strategy and Secondary   Students' Attitude to Physics. *The African Symposium: An online journal of the African   Educational   Research Network. 11*(2), 119-127.

ALshammari, M. K. (2015). The effect of Conceptual Maps Strategy in Teaching Foundations   Curriculum   on the Achievement of students of Afif Education College in Saudi Arabia.   *British Journal of Education, 3*(4), 37-47.

Ausubel, D. P. (1968). *Educational Psychology: A Cognitive View*. New York: Holt,   Rinehart, and Winston.

Aziz, T. & Rahman, A. (2014). Effect of Concept Mapping Strategy on Students' Achievement   in   Science   at Secondary Level. *Research Gate*, https://www.researchgate.net/publication/   281848894.

Chawla, J. (2015). Effect of Concept Mapping Strategy on Achievement in Chemistry of   IX   Graders   in Relation To Gender. *International Journal of Science and Research (IJSR),   4*(12), 531-536.

Chawla, D. J. & Singh, D. G. (2015). Effect of Concept Mapping Strategy on Achievement in   Chemistry among IX Grader Girls. *International Journal of Informative & Futuristic Research, 3*(3), 1036-1044.

Chiou, C. (2008). The effect of concept mapping on students' learning achievements and interests.   *Innovations in Education and Teaching International, 45*(4), 375–387.

Emmanuel, O. E. (2013). Effects of concept mapping strategy on students' achievement in   difficult chemistry concepts. *Educational Research, 4*(2), 182-189.

Filgona, J., Filgona, J., Sababa, L. K., & Ndatuwong, L. G. (2016). Effects of Concept Mapping and Brainstorming Instructional Strategies on Junior Secondary School Students' Achievement in Social Studies in Mubi Educational Zone, Nigeria. *British Journal of Education, Society & Behavioural Science, 18*(2), 01-18.

Gaitonde, U. N., Tembe, B. L., & Kamble, S. K. (2017). Computer Assisted Collaborative   Concept Mapping in Engineering Education. *International Journal of Information and   Education   Technology,   7*(6), 469-473. doi: 10.18178/ijiet.2017.7.6.914.

Jack, G. U. (2013). Concept Mapping and Guided Inquiry as Effective Techniques for Teaching   Difficult Concepts in Chemistry: Effect on Students' Academic Achievement. *Journal of   Education   and   Practice, 4*(5), 09-15.

Jedge. O. J., Alaiyemla, F. F., and Okebukola, P. A. (1990). The effect of concept mapping on   students' anxiety and achievement in biology. *Journal of Research in Science Teaching*,   *27*(10), 951-960.

Jonassen, D. H., et. al. (1997). Concept mapping as cognitive learning and assessment tools.   *Journal   of Interactive Learning Research*, 8(3/4), 289-308.

Jena, A. K. (2012). Does constructivist approach applicable through concept maps to achieve   meaningful learning in Science? *Asia-Pacific Forum on Science Learning and Teaching,   13*(1), 1-23.

Martins-Omole, M. I., Yusuf, H. O., & Guga, A. (2016). Effects of Concept Mapping and Experimental Techniques in Teaching Biology in Secondary Schools in Federal Capital Territory Abuja, Nigeria. *European Journal of Education Studies, 2*(6), 119-130.

N.C.E.R.T. (2013). *Pedagogy of Science: Physical Science – Textbook for B.Ed. (Part –I)* (1st ed.), New Delhi.

Novak, J. D. (1979). Applying psychology and philosophy to the improvement of laboratory teaching. *The American Biology Teacher*, *41*(8), 466-474.

Novak, J. D. (1990a). Concept mapping: a useful tool for science education. *Journal of Research in Science Teaching*. *27*(10), 937-949.

Novak, J. D. and Musonda, D. (1952). A Twelve Year Longitudinal Study of Science Concept Learning, *American Educational Research Journal,* XXVII, 154-177.

Parsa, Y. Z., & Nikbakht, N. A. (2004). Concept mapping as an educational strategy to promote meaningful learning. *Journal of Medical Education, 5*(2), 47-50.

Sakiyo, J., & Waziri, K. (2015). Effect of Concept Mapping and Inquiry Teaching Methods on Secondary School Students' Academic Achievement in Biology. *Indo-African Journal of Educational Research, 3*(2), 01-05.

Shakoori, M., Kadivar, P., & Sarami, R. (2017). The Effect of Concept Mapping Strategy as a Graphical Tool in Writing Achievement among EFL Learners. *International Journal of Information and Education Technology, 7*(5), 357-360.

Shamsuddin, I. M., Aminu, I., Shamsiyya, A., & Adamu, A. M. (2017). Influence of Computer Assisted Concept Mapping Instructional Strategy on Students Performance in Chemistry. *American Journal of Applied and Industrial Chemistry, 3*(4), 39-45.

Sharma, L., Harsana, G., & Sharma, K. (2013). Study of Effectiveness of Using Concept Maps in Science among VI Grade Students. *International Journal of Scientific and Research Publications, 3*(4), 01-14.

Stel, M. V. D., & Veenman, M. V. J. (2008). Relation between intellectual ability and metacognitive skillfulness as predictors of learning performance of young students performing tasks in different domains. *Learning and Individual Differences, 18*(1), 128- 134. https://doi.org/10.1016/j.lindif.2007.08.003.

Trwobridge, J. E., and Wandersee, J. H. (1994). Identifying critical junctures in learning in a college course on evolution. *Journal of Research in Science Teaching, 31*(5), 459 – 473.

Vrugt, A., & Oort, F. (2008). Metacognition, achievement goals, study strategies and academic achievement: pathways to achievement. *Metacognition and Learning, 3*(2), 123-146.