

Effect of Contextual Teaching and Learning process on Learning Attainment in Science – A mixed methods study

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Abstract: It is necessary that the process of learning needs to generate meaning by linking academic content with the context of learner's daily life. Contextual Teaching-Learning may help to break down the barriers between the different learning environments (home, school community) and thus create a context more conducive to learning. So the study has been carried out to find out the Effectiveness of Contextual Teaching-Learning Process on learning attainment in science among Students of class VIII by employing the embedded mixed methods design in the Navodaya school. The learning attainment test in science was developed based on the learning outcomes at the national level for class VIII by NCERT. Results have shown that the use of Contextual teaching-learning approach was effective in improving learning attainment among the students of class VIII.

IndexTerms: Contextual Teaching-Learning, Learning attainment.

I. Introduction

All the realities in the universe reside in the web of relationships, and all the meanings derive from these relationships. This pattern of relationship is emphasized by the theoretical physicist and mathematical cosmologist Brian Swimme and his colleague Thomas Berry, remarked as: "To be is to be related, for relationship is the essence of existence. Every particle in the universe is connected to every other particle in the universe... Alienation for a particle is a theoretical impossibility. For galaxies, too, relationships are the fact of existence. Each galaxy is directly connected to the hundred billion galaxies of the universe....Nothing is itself without everything else" (Swimme & Berry, 1992, p. 77, as cited in 'Contextual Teaching and Learning' by Elaine B. Johnson, 2002). Biologist Lynn Margulis, in collaboration with Dorian Sagan (1995), reinforces this perspective. She explains that everything on earth is part of a web of relationships. All life forms on the earth, including all plants and animals, constantly interact with their environment. Nature is interdependent. Independence does not exist in nature. It is composed of innumerable patterns of relationships. Thus the 'context' is understood as a pattern of relationships in one's environment (Elaine B. Johnson, 2002). Her efforts to reform education prompted her to experiment with an array of teaching strategies that evolved gradually into the contextual teaching and learning system. She provides the definition for Contextual Teaching and Learning (CTL) supported by psychology, neuroscience, and the findings of physics and biology. She has given clarity to the CTL from the point view of brain research, the discovery of biologists and physicists, and the insights of psychology. According to her, the CTL system succeeds because it demands young people to act in ways that are natural to human beings. That is, it conforms to the brain's functions, to basic human psychology, and to three principles that modern biology and physics have discovered permeating the entire universe. The three principles interdependence, differentiation, and self organisation – infuses everything that lives, including human beings. The stunning correspondence between the way nature works and CTL gives the understanding why CTL provides the pathway to academic excellence.

Quantum physicists, cosmologists, and biologists working independently have recognized these three principles infusing everything: galaxies and atoms, planets and sub-atomic particles, and microorganisms and brain cells. Detailed observations by the scientists reveal that from electron to galaxy, the entire universe is considered to be sustained and ordered by three principles, those of interdependence, differentiation, and self organization (Capra, 1996; Johnson and Broms, 2000; Margulis and Segan, 1995; Swimme and Berry, 1992). These principles organize and sustain everything, including all living systems. Because human organizations such as the family, work place, school, and neighbourhood are living systems and they certainly have the potential to embody the principles of interdependence, differentiation, and self organization that hold together living entities, the earth, and the universe. And it has been proposed that the components of CTL system correspond to these three principles of nature. "Contextual teaching and learning succeeds primarily because the central aim – to find meaning through connecting academic work with daily life – and its various elements correspond to nature's three underlying principles, as well as to the discoveries of psychology and neuroscience" (Johnson E B, 2002).

The Principle of Interdependence and CTL

The principle of interdependence calls educators to recognize their connection to one another, their students, the community, and the earth. It demands them to build relationships in all they do.

The Principle of Differentiation and CTL

The principle of differentiation urges us to wait for each student to express themselves. Thus it allows students to express their uniqueness that can help them achieve mastery in the rich learning environment provided by the CTL system.

The Principle of Self-Organization and CTL

Aligning with this principle, the central aim of the CTL system is to help students achieve academic excellence, acquire career skills, and develop character by connecting school-work with their own experiences and knowledge. When students connect academic material with the context of their own personal circumstances, they are engaged in activities that embody the principle of self-organization.

Perspectives on Contextual Teaching and Learning (CTL)

Contextual Teaching and Learning (CTL) has been defined in different ways by numerous experts. Several definitions of CTL have emerged in the process of finding the meaning of CTL.

The most acknowledged definition of CTL was developed through a national project funded through the US Department of Education's Office of Vocational and Adult Education and the National School-to-work Office. It defined CTL as: "...a conception of teaching and learning that helps teachers relate subject matter content to real world situations and motivates students to make connections between knowledge and its applications to their lives as family members, citizens and workers...." (Berns and Erickson, 2001)

Elaine B. Johnson, considered as a recognised authority on brain-compatible teaching, contextual teaching and learning, and principle of leadership has viewed CTL as a holistic system that consists of interrelated parts that, when interwoven, produce an effect that exceeds what any single part could achieve. She defines, "the CTL system as an educational process that aims to help students see meaning in the academic material they are studying by connecting academic subjects with the context of their daily lives, that is, with the context of their personal, social, and cultural circumstances. To achieve this aim, the system encompasses the following eight components: making meaningful connections, doing significant work, self regulated learning, collaborating, critical and creative thinking, nurturing the individual, reaching high standards, using authentic assessment"(Johnson E B, 2002).

II. Rationale of the study

It is important to see how the new world view arising from science shapes our attitudes. It is the relationship among the parts – their context – that gives meaning. It is necessary that the process of learning needs to generate meaning by linking academic content with the context of student's daily life. Contextual Teaching-Learning may help to break down the barriers between the different learning environments (home, school community) and thus create a context more conducive to learning. In this view, NCF 2005 has emphasized on the significance of contextualizing the education. Since the local environment and the child's experiences are the entry points for receiving knowledge, the learning should take place in the context of a child's world.

Various authors (Schank & Cleary, 1995; Resnick, 1987; Johnson, 2002) have suggested that the school system that has emerged over the last centuries produced adverse effects on learning because of the absence of real world context (Westera, 2009). They have argued that school tends to be an internally focused world in itself that promotes a fundamental separation between the learning and the outside world. As a result of school children are unable to make connections between what they have learnt and how that knowledge will be used.

Introduction of contextual teaching learning in science education attempts to address these problems. Hence, the study was carried out to find out the effectiveness of contextual teaching learning on learning attainment in science among the class VIII students.

III. Methodology*Design and Sample*

This study has employed embedded mixed methods design (embedded quasi experimental design). In the embedded mixed methods design, the researcher shall combine the collection and analysis of both qualitative and quantitative data within a traditional quantitative research design or qualitative research design (Caracelli & Greene, 1997; Greene, 2007).

Though the researcher has planned an experimental study as the "primary" focus, the researcher has identified the need of qualitative data in order to capture many of the issues and the essence of Contextual Teaching-Learning, which could not be handled only with quantitative design. Therefore, the researcher has embedded a "secondary" qualitative strand within the quantitative quasi experimental design to examine the experiences of the students in the process of learning during the implementation of the intervention on Contextual Teaching-Learning in science.

Quantitative Strand

Quasi experimental design – The present study was employed with the non-equivalent control group design. It is one of the most widespread experimental designs in educational research, involves an experimental group and a control group, both given a pre-test and a post-test, but only the experimental group receives the treatment.

Qualitative Data Collection

The qualitative data was obtained through classroom observations, students' anecdotes, students' self reports (student maintained reflective diaries), portfolios, focus group discussion was carried out with the students. The data obtained through these modes yielded the information about participant's perceptions, opinions, and experiences about contextual learning.

The qualitative data was collected with the intention of understanding the experimental results by incorporating the perspectives of individuals and to get an understanding of participant views within the context of experimental intervention.

Instrumentation

The "learning attainment test" was developed by the researcher. This test was developed to measure the learning attainment, with the intention to assess the expected learning outcomes reached by the students as indicated in the science learning outcomes at the national level for class VIII by NCERT. The test consisting of 80 questions was given to experts. After experts' validation appropriate modifications were made and 54 items were selected for the pilot study of learning attainment test. Item analysis was carried out after pilot test. As suggested by Noll et al. (1995) the items with a difficulty value in the range of 21-80% and discriminating power greater than 0.20 were selected for the final test. Since adequate number of items were not available with DP greater than 0.20 and DI in the range of 21-80%, some adjustments in these limits were found necessary. Items with DI above than 80% and within 90% were retained and items with DP 0.19 and above were retained. Internal consistency of the learning attainment test was measured using Cronbach's alpha reliability coefficient. The reliability coefficient (Cronbach's Alpha) obtained for the learning attainment test was 0.853.

IV. Statistical techniques used

The researcher has employed ANCOVA to test the hypotheses using SPSS version 20.

V. Research Questions

To what extent did Contextual Teaching-Learning had its effect on learning attainment of the students of class VIII in science?

VI. Objective

To study the effect of Contextual Teaching-Learning on learning attainment of the students of class VIII.

VII. Hypothesis

The performance of experimental group students on learning attainment will be significantly higher than the control group students as a result of undergoing the treatment of contextual teaching-learning process.

H_{01} There is no significant difference between the post test scores of experimental and control group students on learning attainment as a result of undergoing the treatment of contextual teaching-learning process in science when pre test score on learning attainment was taken as covariate.

Table 1

Analysis of covariance associated with learning attainment of experimental and control group with pre test scores as covariates.

Dependent Variable: Post-test score on learning attainment

Source	Sum of Squares	df	Mean Square	F	Sig.
Learning attainment test	8941.318	1	8941.318	123.438	0.000
Pre test on LAT	826.879	1	826.879	11.415	0.001
Group	14692.375	1	14692.375	202.834	0.000
Error	6664.079	92	72.436		
Total	89647.000	95			
Corrected total	21360.589	94			

^aR Squared = 0.688 (Adjusted R Squared = 0.681)

Table 2

Adjusted mean scores of learning attainment of experimental and control group when pre- test on learning attainment was taken as covariate

Name of group	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
Experimental group	39.696 ^a	1.257	37.199	42.194
Control group	14.193 ^a	1.244	11.722	16.664

Table 1 reveals that the difference in the mean post test scores in learning attainment of the experimental group and control group is significant with $F=202.834$, $p<0.01$. Hence the null hypothesis (H_{01}) stating that there is no significant difference between the post test scores of experimental and control group students on learning attainment in science when pre test scores on learning attainment was taken as covariate is rejected. Hence the alternative hypothesis i.e. there is a significant difference between the post test scores of experimental and control group students on learning attainment in science when pre test scores on learning attainment was taken as covariate is accepted.

It was also seen from table 2 that the adjusted mean score on learning attainment test of experimental group (mean=39.69) is significantly higher than that of the control group (mean=14.19), indicating that the contextual teaching learning process is effective in improving the learning attainment of class VIII students in science.

VIII. Qualitative analysis on learning attainment:

The students belonging to experimental group had expressed their experiences in their own words, which provide the details of the learning process that they have undergone. And these impressions convey that the classes were interesting, enjoyable, and the experience gained would make learning long lasting and could be applied in different situations in their life. The students' voices which were recorded are as follows. It is to be noted that they are unedited.

“The classes were enjoyable and the method of learning was nice. I was eager to learn the things while madam was teaching”.

“By learning in this way, we will never forget. For example, if we learn anything by reading or asking teacher, we will forget after some years. By doing practically we did not forget anything because we saw the things and experienced it by our own. So this learning is useful for everybody”.

“It was always a lecture we could expect from other teachers, I also expected the same from her but it was not at all like that there was something new in the method of learning from her. It was different”.

“It was a very nice experience she made us to learn things in different ways, she made us to learn how to think and act. She taught us in a way which we wanted to learn”.

“I have learnt many things from her class. I have improved many things; it was a wonderful journey with her. The knowledge I gained will help me in other situations”.

The CTL demands learners to be in collaboration with the community in the process of learning. They need to be collaborative with different people at work or different places of work. For example: discussion with a doctor, a nurse, farmers, and visiting the bakery. A doctor was with us in online mode to discuss the effect of microorganisms on human body, as a part of the lesson on microorganisms. A parent, who was working as a staff nurse in a government hospital, had interacted with the students on the lesson “fibres and plastics” and gave details about the safe disposal of hospital wastes. Different ways of disposals like burning, recycling, and burying anatomical wastes were discussed.

In order to understand microorganisms as friend, students visited the bakery and found the use of yeast in the preparation of different bakery products. Some of the photographs sent by them are as follows:



Figure 1: Preparation of bakery products using yeast

The CTL creates a genuine interest among the learners making them the proactive learners. Applying academic knowledge to real world contexts and immediate problems instil in students, the habit of reasoning logically, to have an open mind, listen to others with genuine interest, think before acting, base conclusions on firm evidences, and exercise imagination. To illustrate another example, a student had sent the following picture drawn based on the lesson “fibres and plastics”. This drawing depicts how the use of a synthetic fibre contributes towards the water and land pollution.



Figure 2: Synthetic fibre leading to land and water pollution

IX. Findings of the study

The study revealed that there is a significant difference between the post-test scores of the experimental and control groups indicating that the Contextual teaching-learning process has been effective in improving learning attainment among the students of elementary level.

Responses of students collected qualitatively and their active involvement in learning which were observed through their samples of work also reflect the learning process that they had undergone.

X. Discussion and conclusion:

With respect to the results of the study, there is a significant difference between the post-test scores of the experimental and control groups indicating that the Contextual teaching-learning process has been effective in improving learning attainment among the students of class VIII in Science. It means, if the students are exposed to contextual teaching-learning process, learning would be meaningful. In the same line are the studies (Sunar, 2013; Nurkholis Majid & Rohaeti, 2018; Samuel & Maxwell, 2020; Abumchukwu et al., 2021), which have shown improvement in the learning efficiency of students at secondary school level though the emphasis was more on chemistry learning.

There is a need to incorporate contextual teaching learning for learning science and technology spheres. It helps to bring in real life contexts and situations showing cultural and social and ecological diversity related to students' background to learn the content.

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