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RESTRUCTURING OF PHYSICS CURRICULUM OF 9TH CLASS STUDENTS IN THE LIGHT OF ATTAINMENT OF OUTCOMES

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Abstract

The present study is an attempt to redesign the physics curriculum of class IX of CBSE board on the basis of the concept of outcome-based learning. The purpose is to address the issues of academic overload and achievement deficits among students learning science subjects. An experimental method was used to conduct the study in which 50 students of 9th grade were selected using simple random sampling technique as a sample of study. The outcome-based physics curriculum with specialized lesson plans to transact the curriculum with innovative teaching pedagogies were developed. The evaluation procedures were also redesigned to evaluate the learning outcomes of the learners. A Pre-test and Post-test control group design was used. Fifty students were randomly assigned to control and experimental groups. The experimental group was taught outcome-based content through innovative pedagogies. The control group was taught ongoing and specified curriculum through prevalent teaching strategies. The comparison of pre-test and post-test scores of experimental and control groups were made to conclude the results. The findings proved that the experimental group students were better than the control group students in terms of learning outcomes. Thus, the findings of the study suggest the need to reform the ongoing curriculum in terms of learning outcomes of the learners and the corresponding pedagogical and evaluation strategies.

Keywords: *Restructuring, Physics Curriculum and Outcomes.*

I INTRODUCTION

Lifelong education in the 21st century is increasingly emphasized. The need for recognizing education not as something which is time bound or only learning about books but as learning about life is felt. A quality education system increases learner's skills and awareness

(Sesha,2012). The investment in education is vital for development of both human capital and the economy (Sesha,2012). The rapidly changing world places new demands on society and especially in the education sector. Skills, attitudes, values, and knowledge about topics such asdigital and data literacy, globalization, literacy for sustainable development, and computational thinking are ever more relevant (OECD,2020). This requires changes in all theaspects of education right from aims of education, curriculum, pedagogy and evaluation. However, to be responsive to new changes, the integration of these novel ideas in the prevalent curriculum needs to be very strategic. Just adding or dumping the new into the existing curriculum is resulting in overcrowding. Earlier, Learning Without Burden (1993) also addressed the issue of an academic burden on students and unsatisfactory learning quality and found that the problem remains unaddressed with the introduction of the new curriculum. "A lot is taught, but little is learned or understood" clearly represented the situation. Joyless learning is found to be one of the results behind the imposition of the prevalent rigorous academic regime. The textbooks are found to serve the purpose of conveying facts instead of inculcating the habit of exploration and thinking. In the organization of syllabi, children's viewpoint is found to be missing. These weaknesses of organization apparently lead to memorization and poor comprehension, both exacerbating the sense of curriculum load. This is not only increasing the academic pressure on teachers and students but is also killing the precious time of students to engage in deep learning. Meeting the diverse needs of learners is also becoming difficult. The overloading of the curriculum is recognized as one of the important issues that need immediate attention. National Education Policy 2020 has also included specialized provisions to address this issue such as the reduction of curriculum content in each subject to its core essentials, to make space for critical thinking and more holistic, inquiry-based, discovery-based, discussion-based, and analysis-based learning. The mandated content will focus on key concepts, ideas, applications, and problem-solving. The OECD Future of Education and Skills 2030 policy analyses of country/jurisdiction curriculum and reform suggest a variety of approaches to balancing content and competencies to address new societal demands while not overloading the curriculum. Students need to learn deeper and not more; their learning time should not be extended nor should students learn at a surface level (OECD, 2020).

The key overall thrust of curriculum and pedagogy reform across all stages should be to move the education system towards real understanding and towards learning "how to learn" instead of "what to learn" (NEP, 2020). Building character and creating holistic and well-rounded

individuals equipped with the key 21st century skills should be the ultimate aims of education (NEP, 2020). Curriculum content should be reduced in each subject to its core essentials, to make space for critical thinking and more holistic, inquiry-based, discovery-based, discussion-based, and analysis-based learning (NEP, 2020).

Particularly, Science education is one of the essential key parts of school curriculum which aims to increase people's understanding of science and the construction of knowledge as well as to promote scientific literacy and responsible citizenship. Apart from imparting knowledge, development of critical thinking and problem solving are the aims of science education. The teaching of science is thus expected to impart training in scientific method, develop scientific attitude and scientific temper (Govt. of India, 1986). At the Secondary Stage, Science is being taught as a composite subject which includes Physics, Chemistry, and Biology (NCERT, 2019). Physics is one of the elective subjects in the Key Learning Area of Science Education. It involves the study of universal laws, and the behaviours and relationships among a wide range of physical phenomena. The overarching aim of the Physics Curriculum is to provide physics-related learning experiences for students to develop scientific literacy, so that they can participate actively in our rapidly changing knowledge-based society, prepare for further studies or careers in fields related to physics, and become life-long learners in science and technology (Rao,2016). The Physics Core Curriculum has two primary goals:

- Student's will value and use science as a process of obtaining knowledge based on observable evidence.
- Student's curiosity will be sustained as they develop and refine the abilities associated with scientific inquiry.

The aims and objectives that were laid down for science education were not implemented up to the mark. The document entitled "Learning without Burden" addressed that when students come to Class XI, they often find themselves without a clue even if they have done well in Class X. The level of abstraction attempted in the senior secondary stage science syllabi and textbooks, especially the physics textbooks, represents a jump in many topics. Repetitions of concepts and information also leads to boredom and a sense of load.

In this connection, National Science Education Standards (1996) emphasized changes in the teaching and content standards. In India, NCERT has brought out the National Curriculum Framework (2005) that viewed a child as a constructor of his knowledge. It also recommended the development of scientific attitudes, values, and creative, critical, and generative thinking among the students and enable them to use their idea in various day-to-day life situations.

National Education Policy 2020 suggested that teaching and learning should be conducted in a more interactive manner; questions should be encouraged, and classroom sessions should regularly contain more fun, creative, collaborative, and exploratory activities for students for deeper and more experiential learning. In all stages, experiential learning should be adopted, including hands-on learning, arts-integrated and sports-integrated education, and story-telling-based pedagogy, among others, as standard pedagogy within each subject, and with explorations of relations among different subjects.

The need is there to decentralize the process of curriculum designing and innovate all the aspects of curriculum along with a commitment to pedagogical innovations to transact the same. The revision in the curriculum needs to ensure the linkage of most of the topics to experiments or activities that can be performed by children and teachers. Right from determining the learning outcomes to pedagogy and to the evaluation of the same, a great transformation is required. Outcome-based learning is a need of an hour. Learning outcomes are written statements of what the successful student/learner is expected to be able to achieve at the end of the program module/course unit or qualification (Adam, 2004). The content needs to be strategically redesigned to include the new concepts and eliminate the repetitive and old concepts. The curriculum transaction strategies need to be innovative to target the learning outcomes. The evaluation methods should align with pedagogy and learning outcomes too.

II STATEMENT OF THE PROBLEM

The rapidly changing world places new demands on society and especially on the education sector. In the process of adapting such changes, some of the important issues are related to curriculum redesigning and curriculum transaction. Curriculum lacks the space to easily add new content without causing overcrowding in the curriculum. In addition to this, there is need for innovative teaching strategies to provide ample opportunities to learners to get deeper and skill based practical knowledge of the concepts rather than grasping only the text content. The report named Learning Without Burden (1993) and National Education Policy (2020) also addressed the issue of academic burden on students and unsatisfactory learning quality and found that the problem remains unaddressed on the introduction of new curriculum. Keeping this issue of academic burden in mind, the curriculum should be redesigned in such a way that it enhances the learning outcomes of the students. Thus, the present research study entitled ***"Restructuring of Physics Curriculum of 9th Class Students in the Light of Attainment of Outcomes"*** has an imminent need and hence undertaken.

Operational Definitions

Restructure: It means to preserve and build upon what has been successful in educating our children by involving different innovative teaching methodologies. In the present study, physics curriculum has been restructured in such a way to render focus on inner abilities of children and to reduce the academic burden so as to bring forth desired outcomes among the children.

Physics: The branch of science that describes the motion and energy of all matter throughout the universe.

Curriculum: In present investigation, it refers to an interactive system of instruction and learning with specific goals, contents, strategies, measurement, and resources.

Outcome: Outcomes can be defined as an amalgamation of a learner's knowledge, skill set, and the ability to leverage them in real life situations. For the purpose of present study, the learning outcomes are measured in terms of academic achievement and these are observable and measurable in terms of; knowledge, skills, abilities and values.

III OBJECTIVES OF THE STUDY

The following objectives have been formulated for the investigation process:

1. To develop Outcome based curriculum of physics of class IX of CBSE.
2. To develop lesson plans based on innovative teaching strategies.
3. To study the achievement in terms of outcomes of the students taught with ongoing teaching strategies and the specified curriculum.
4. To study the achievement in terms of outcomes of the students taught with innovative teaching strategies and outcome-based curriculum.
5. To compare the achievement in terms of outcomes of the students taught with the already specified curriculum with those taught with the outcome-based curriculum.

IV HYPOTHESES OF THE STUDY

The following Hypotheses have been formulated to test the achievement of the Objectives;

1. There will be no significant mean difference between the pre-test and post-test scores of control group in their achievement in terms of outcomes of the students taught with ongoing teaching strategies and the specified curriculum.
2. There will be no significant mean difference between the pre-test and post-test scores of an experimental group in their achievement in terms of outcomes of the students taught with innovative instructional strategies and outcome-based curriculum.

3. There will be no significant difference in the achievement in terms of outcomes of the students taught with ongoing teaching strategies and specified curriculum to the students taught with innovative instructional strategies and outcome-based curriculum.

V METHODOLOGY

The population in the present study was defined as the students of CBSE schools in Amritsar City, Punjab, India, and from these schools, one was selected randomly. Fifty students of grade IX were taken from the selected CBSE-based secondary school using a Random sampling technique. Keeping in mind the need of the study, experimental research, A Pre-test Post-test control group design was used. Fifty students were randomly assigned to an experimental and control group equally. The outcomes-Based curriculum was developed by selecting two chapters of physics namely-Motion and Laws of Motion of IX class to check the attainment of learning outcomes of students as per the ongoing schedule of the school's academic session. For necessary omissions, however, the curriculum's overburdening was also taken into consideration. Learning outcomes covering every domain in behavioural terms were determined. The draft was sent to five subject experts for evaluation and changes were made as per the recommendations. The innovative instructional strategies that ensure the active involvement of learners in the learning process were chosen for the transaction of an outcome-based curriculum taking into consideration the desired outcomes. The investigator used role-playing, brainstorming, story-telling, and jigsaw techniques as instructional strategies. The achievement test to compare the academic achievement of learners in physics was constructed by the investigator herself. To determine the attainment of outcomes, multiple-choice questions, essay-type questions, group discussions, and puzzles were included in the achievement test. There was no negative marking scheme. The content validity of the test was ensured by getting the test approved by five subject experts.

Self-constructed achievement test was administrated to both groups as a pre-test. The experimental group was taught with the help of innovative strategies using lesson plans and the control group was taught with the traditional method. The achievement test was again administrated as Post-test. Finally, the mean scores of pre-tests and post-test are compared. Quantitative analysis was done by computing gain achievement scores in physics among 9^{th} grade students to test the hypotheses.

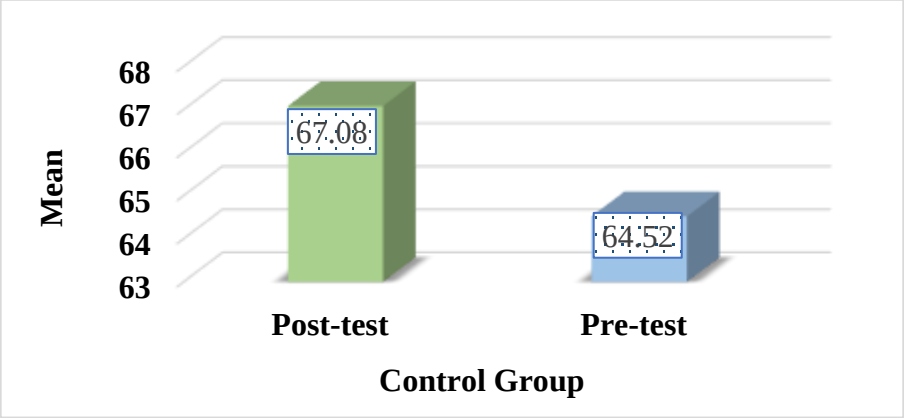
VI STATISTICAL TECHNIQUES EMPLOYED

The following techniques have been used to analyse the data:

1. Descriptive Statistics
2. t-test
3. One Way ANOVA
4. Graphical Representations

VII RESULTS

1.1 Significance of difference between the pre-test and post-test scores of control group in their achievement in terms of outcomes of the students taught with ongoing teaching strategies and the specified curriculum.



Graph 1: Showing Mean Achievement Gain Scores in Pre-test and Post-test of Control Group

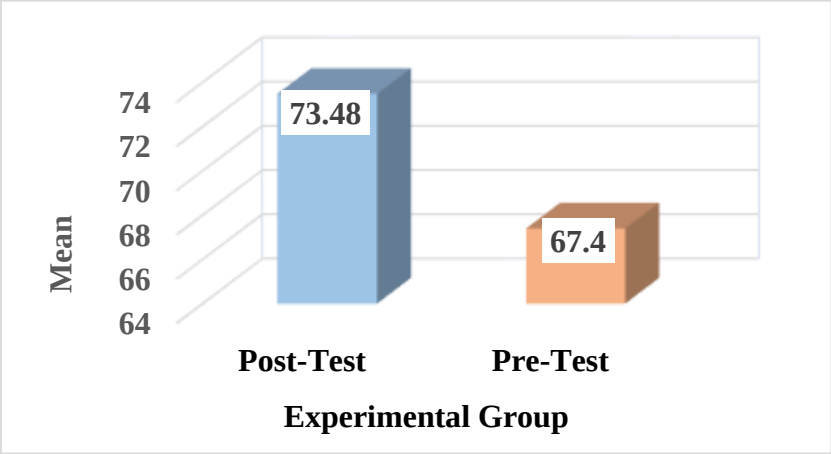
As shown in the graph 1, the mean of the pre-test scores of control group taught with ongoing teaching strategies is found to be 64.520 and mean of post-test scores of control group is found to be 67.080. The post-test scores of control group are more than the pre-test scores of the control group.

Table 1.1: Showing the Mean, Standard Deviation, Standard Error Mean, t-value and p -value of Control Group (On the Score of Achievement)

Group	Test	N	Mean	Std. Deviation	Std. Error Mean	t-value	p-value
Control Group	Pre-Test	25	64.520	12.5071	2.5014	3.351	0.003
	Post-Test	25	67.080	10.5353	2.1071		

From the table 1.1, it is clear that the p-value is 0.003 which is less than 0.05 level of significance, thus there is a statistical difference between pre-test and post test scores of control group. Hence, the null hypothesis framed to ascertain that *"There will be no significant mean difference between the pre-test and post-test scores of control group in their achievement in terms of outcomes of the students taught with ongoing teaching strategies and the specified curriculum."* *is rejected.*

1.2 Significance of difference between the pre-test and post-test scores of an experimental group in their achievement in terms of outcomes of the students taught with innovative instructional strategies and outcome-based curriculum.



Graph 2: Showing Mean Achievement Gain Scores in Pre-test and Post-test of Experimental Group

A careful glance at graph 2 reveals that the mean of pre-test scores of an experimental group taught with innovative teaching strategies is found to be 67.400 and the mean of post-test scores of the control group is 73.480. The post-test scores of the control group are more than the pre-test scores of the experimental group.

Table 1.2 Showing the Mean, Standard Deviation, Standard Error Mean, t-value and p-value of the Experimental Group (On the Score of Achievement)

Group	Test	N	Mean	Std. Deviation	Std. Error Mean	t-value	p-value
Experimental Group	Pre-Test	25	67.400	10.5000	2.1000	7.286	0.00
	Post-Test	25	73.480	9.2876	1.8575		

From table 1.2, it is clear that the p – value is 0.00 which is less than 0.01 level of significance. Thus, there is a statistical difference between the pre-test and post-test scores of an

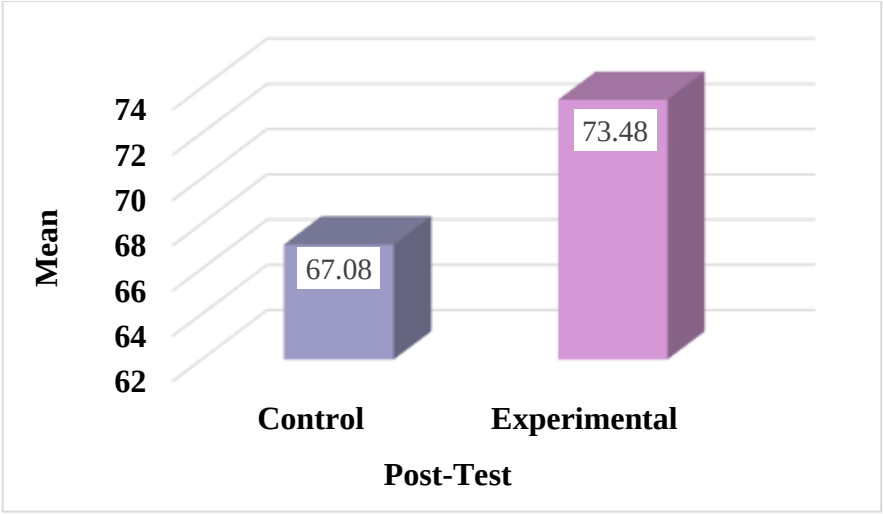
experimental group. Hence, the null hypothesis framed to ascertain that "*There will be no significant mean difference between the pre-test and post-test scores of an experimental group in their achievement in terms of outcomes of the students taught with innovative instructional strategies and outcome-based curriculum" is rejected.*

1.3 Significance of difference in the achievement in terms of outcomes of the students taught with ongoing teaching strategies and specified curriculum to the students taught with innovative instructional strategies and outcome-based curriculum

Table 1.3 Showing the Mean, Standard Deviation, Standard Error Mean and Standard Error Difference of Control and Experimental group
(On the Post-Test Score of Achievement)

Test	Group	N	Mean	Std. Deviation	Std. Error Mean	Std. Error difference
Post-Test	Control	25	67.080	10.5353	2.1071	2.8089
	Experimental	25	73.480	9.2876	1.8575	

From table 1.3, it is clear that the mean of post-test scores of control group taught with ongoing teaching strategies is 67.08 and the mean of post-test scores of an experimental group taught with innovative teaching strategies is 73.48. The mean of post-test scores of an experimental group is more than the post-test scores of the control group.



Graph 3: Showing Mean Achievement Gain Scores in Post-test of Control Group and Experimental Group

Table 1.4 Showing N, Sum, Average and Variance of Control and Experimental Group (On the post-test score of Achievement)

Test	*Group*	*N*	*Sum*	*Average*	*Variance*
Post-Test	*Control*	*25*	*1677*	*67.08*	*110.9933*
	Experimental	*25*	*1837*	*73.48*	*86.26*

Table 1.5 Showing Summary of ANOVA on the Score of post-tests of Control and Experimental Group

Source of Variation	**Sum of Squares**	**df**	**Mean Square**	**F-Value**	**Level of Significance**
Between Groups	512	1	512	5.191294	0.027
Within Groups	4734.08	48	98.62667		
Total	5246.08	49			

From table 1.5 it is clear that the p-value is found to be 0.027 which is less than the significance level of 0.05. Hence, the null hypothesis framed to ascertain that "*There will be no significant difference in the achievement in terms of outcomes of the students taught with ongoing teaching strategies and specified curriculum to the students taught with innovative instructional strategies and outcome-based curriculum" is rejected.*

VIII DISCUSSION ON THE FINDINGS

The post-test scores of the control group were more than the pre-test scores of the control group and the post-test scores of the experimental group were more than the pre-test scores of the experimental group too. This is representing the effect of using innovative teaching strategies to transact outcome-based curriculum. The mean of the post-test scores of the experimental group was more than the mean of the post-test scores of the control group representing that the experimental group performed better than the control group when taught through innovative strategies for the transaction of the outcome-based curriculum.

The present study was delimited to IX Class students studying physics of Amritsar city affiliated with the CBSE Board only. The physics curriculum was restructured in such a way that learning outcomes remains same and for this syllabus of first term of class 9th affiliated to CBSE board was selected which consists two chapters namely- Motion & Laws of Motion. The restructuring was carried out while keeping in mind that each chapter contains all of the crucial concepts, terms and principles. However, the overburdening of the curriculum was also taken into account for required omissions. The criteria used to define learning outcomes and evaluate evaluation processes remain same for both control and experimental groups. The innovative strategies used were limited to role-playing, brainstorming, story-telling, and jigsaw techniques only. This study was conducted at very narrow level and for better generalisation similar studies can be conducted for complete physics curricula, other subjects, and other innovative teaching strategies as well.

IX CONCLUSION

In the 21st century, the world is changing as well as education is also changing. According to the results of this research, it can be concluded that innovativeness by virtue of its nature is an essential feature of an educational program. To make it more impactful when the curriculum is reduced to its core essentials it automatically reduces the burden on the learners. As a result, the imperatives of new times, new demands, and new visions assign more innovative strategies such as; the constructivist approach, activity-based method, story-telling, jig saw technique, etc. are very helpful to make classroom interaction very effective. No innovative teaching and learning method can replace the traditional teaching method in teaching but rather supports it. Therefore, we must also respect such innovations and promote innovative teaching strategies and new ideas and practices in our schools as it will enhance the learning outcomes of the children.

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