



# STUDY ON EFFECTIVENESS OF PROJECT-BASED-LEARNING (PBL) APPROACH TO TEACHING OF SCIENCE AT SECONDARY SCHOOLS

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## ABSTRACT

Project-Based Learning (PBL) is a teaching learning approach, which is widely accepted as a new challenging alternative model to achieve maximum learning among the learners. This approach is more applicable to Science teaching and learning. PBL is a project based learning approach, which engages learners to sharpen 21st century skills and contents. PBL is an approach to learn any subject with in-depth understanding of the concepts. PBL in science teaching and learning is an activity based approach, engaging learners to work in groups and design their own to solve the given task.

31 practising school teachers at secondary levels of Tamil Nadu state of India were given training on PBL approach of teaching science, and directed them to implement this method in their regular classroom situations during the first year of training. A research tool was prepared to study the effectiveness of PBL method of teaching science at secondary school levels. A field survey was made in the second year of study to find out to what extent PBL was implemented in those schools, and how effectively PBL had been implemented and used in the school system. In this study, 1309 students participated in the process. The finding of the present study suggests that all the schools under study have successfully implemented PBL, and a positive correlation was achieved through this study.

**KEY WORDS:** Project-based learning, PBL, secondary school, science teaching, science learning.

## Introduction

There are various methodologies of teaching science in a classroom that include methods such as lecture, demonstration, lecture-cum-demonstration, experimental, project, ICT, field trip, Project-based learning (PBL) etc. Those students exposed to lecture method only have shown scoring consistently less than those who have some form of active engagement (Raghavan, 2010). The methodology selected for instruction should enable students learn how to learn and should sow the seeds for motivation to continue learning, leading to meaningful learning.

PBL provides the opportunity to learn and practice skills that traditional instruction often ignores – working in groups, making choices, monitoring progress, thinking deeply about a problem or challenge, and communicating what has been learned. In short, PBL helps students not only learn content but also the 21st-century skills they will need to thrive in a quickly changing, globally connected world (John Mergendoller, 2014). In a conventional project method, teachers usually assign projects to students that are related to different topics or concepts to make them self learning. Teachers select a number of topics found in science textbook and assign them to the students by forming different groups. In this kind of project method, only one group or few individual learners of the group are able to explore and master the assigned topics, and others are not aware of the work executed by their class mates. Moreover, it is very difficult and time consuming for the teachers to monitor and supervise several projects assigned to the class of many groups.

PBL is an alternative strategy which is effectively used to enhance the learning capacity of the students (Sylvia Chard, 2001). It needs an in-depth investigation of the topic. As an alternative to the conventional one, in a typical PBL setup the entire class is involved on a common project or it can be assigned to a group with different PBL tasks selected by the class teacher on a theme. The outcome of PBL is greater understanding of a topic, deeper learning, higher-level reading, and increased motivation to learn (Bell, 2010). PBL integrates knowing and doing. PBL refocuses education on the student, not the curriculum--a shift mandated by the global world, which rewards intangible assets such as drive, passion, creativity, empathy, and resiliency. These cannot be taught out of a textbook, but must be activated through experience (Markham, 2011).

In PBL, students work in groups and learn about a subject by addressing a problem and issues connected with it. The peer group students create knowledge share among themselves what they have acquired during the process of project based learning.

Sl. No.	Conventional Project	PBL
1	It is one mode of curriculum transaction	Connecting curriculum to daily life
2	One or simple task/activity	Series of tasks/activities
3	A means of scientific inquiry	The driving question drives them to meaningful answers
4	Different topics assigned to different groups	Same topic assigned to all groups
5	Only the group explores to the particular topic	Students work on various concepts of the topic
6	Monitoring and supervision becomes difficult and time consuming	Students themselves decide how to approach the problem

**Advantages of PBL:** There are many advantages of PBL, main points of which are highlighted below:

- **Motivation to learn:** Passive children in the class will be highly motivated to participate in the activities of the project work with great enthusiasm.
- **High performance:** PBL can inculcate certain values in students such as curiosity, quest for knowledge, courage to question, tolerance, search for perfection and leadership quality.
- **Communication skills:** Collaborative learning will improve communication skills both written and oral, as well as the ability to work with others and acceptance of personal responsibility.
- **Joyful learning:** This method will make science learning an interesting and a pleasurable activity.

## Objectives of the study

The specific objectives of the study were:

- To train the secondary school teachers in PBL approach to teaching of Science
- To guide the teachers in implementing the PBL approach in their regular classroom; and
- To study the effectiveness of PBL approach to teaching of Science at secondary level.

**Research Design and Participants**

The study was designed to find out the effectiveness of project based learning at secondary level. The present study involved 25 project schools spreading across four districts of Tamil Nadu (TN), India, namely Salem, Namakkal, Dharmapuri and Krishnagiri. Thirty one (31) Key Resource Persons (KRPs) – 25 practicing teachers and 6 lecturers from District Institute of Education and Research (DIET) of Tamil Nadu state were given training on PBL method of teaching science at Regional Institute of Education (NCERT, New Delhi), Mysore – 570 006, during the first year and it was made sure of two requirements that these teachers/lecturers would give training to secondary school teachers of the state in a cascade mode, and they would implement PBL approach in their regular classroom situations.

**Field visit for data collection:**

A suitable research tool was prepared to find out the effectiveness of the study by framing questionnaires targeting the teachers, students and school authorities. Field visit was done by a team of two Junior Project Fellows, for the data collection. The PBL was implemented by the practicing teachers during the next academic year.

A baseline survey before the experiment and at the end of the implementation was conducted. The data was collected from schools – Headmasters (HMs), teachers and students through questionnaires, and observations from site visits, and an analysis of the data was developed from the project. The research instruments include:

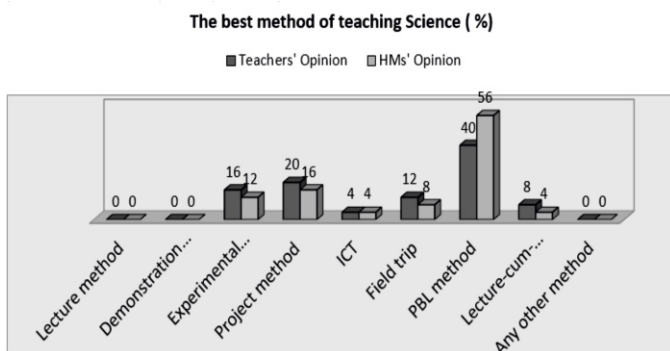
- Teacher Questionnaire,
- Student Questionnaire,
- School Headmaster Questionnaire, and
- Classroom Teaching Observation

The data collected through the above instruments were analyzed and the results are presented in the following paragraphs.

**Results**

**Table.1: Teachers and Headmasters were asked about their opinion regarding the best method of teaching and learning Science subject. The responses are presented in Table 1 and Figure 1.**

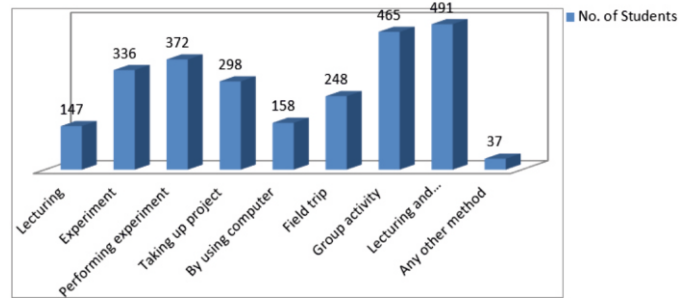
Sl. No	Methods of teaching Science	HMs response %	Teachers response %
1.	Lecture method	0	0
2.	Demonstration method	0	0
3.	Experimental method	16	12
4.	Project method	20	16
5.	ICT	4	4
6.	Field trip	12	8
7.	PBL method	40	56
8.	Lecture-cum- demonstration	8	4
9.	Any other method	0	0



**Fig. 1: A graph showing the opinions of HMs and Teachers about the best method of teaching and learning Science at secondary levels in Tamil Nadu state**

Fig.2 shows that the best ways of learning included lecturing and demonstration (491), followed by group activity (465), by performing experiment (372), and by showing experiment (336) among many other ways. From this response, it is revealed that students wanted to learn by various approaches of teaching and learning of science, and not just listening to the teacher centric lecture method.

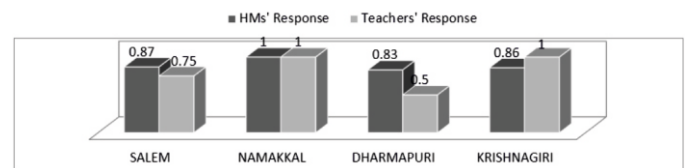
**Best ways to learning of Science**



**Fig.2: Students' response to the best way of learning Science**

**Implementation of PBL**

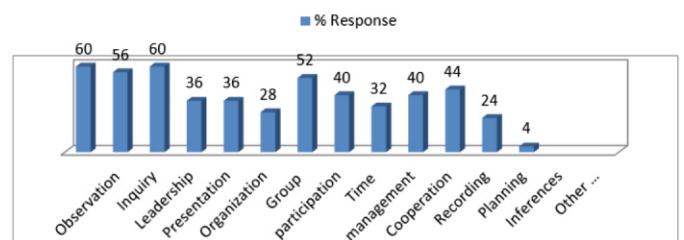
**Implementation of PBL method in secondary schools in TN**



**Fig.3: A graph showing the implementation of PBL approach in teaching Science in secondary schools in the four districts of Tamil Nadu**

Fig.3 shows that the majority of the HMs has opinion that teachers have implemented the PBL approach in their schools and also majority of the teachers (75-100%) have implemented PBL approach of teaching science at secondary level. In Namakkal District, it is observed that PBL is implemented in all the schools under study.

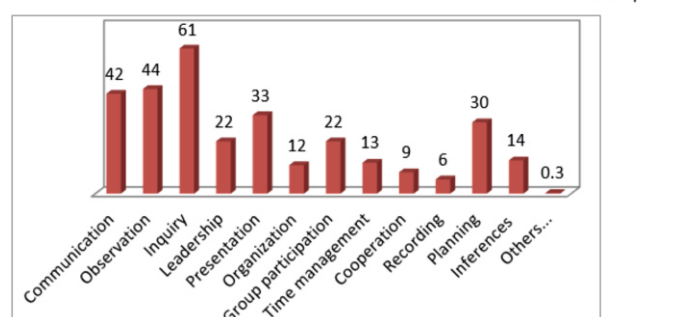
**Various 21st Century skills that teachers wanted to infuse among the students**



**Fig.4: The various 21<sup>st</sup> century skills that teachers wanted to infuse among the students through PBL approach of teaching Science**

Fig.4 shows that majority of the teachers (52-60%) wanted to infuse various skills such as communication, inquiry, observation and group participation among the students by using PBL approach.

**Students Response to Learning various skills through PBL approach of learning Science**

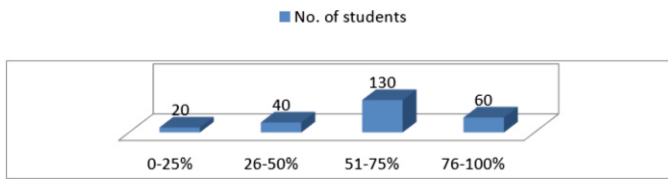


**Fig.5: Students Response indicating the percentage of learning various skills through PBL approach of learning Science**

Meanwhile it was observed that the majority of students responded that skills such as inquiry, observation, communication and presentation were achieved among other skills through PBL approach of learning science (Fig.5).

**Students' Interest for Learning Science through PBL approach**

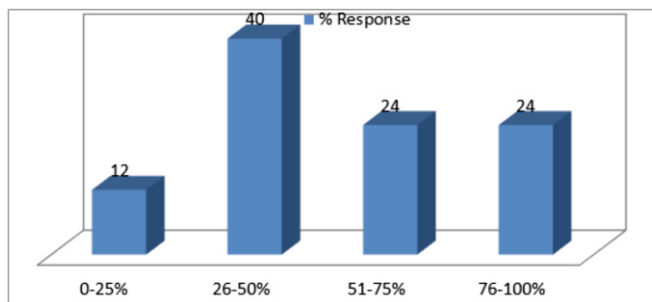
**Students' level of Interest for Learning Science through PBL approach**



**Fig.6: Students options for their interest in learning Science through PBL approach**

Students were asked four options as to which level (0-25%, 26-50%, 51-75% or 76-100%) they were interested to learn Science through PBL. Maximum of the students opted for 51-75% of interest in learning science through PBL approach. Some district teachers reported as 0-25%, 26-50%, 76-100% of students have shown interest in learning science through PBL approach (Fig.6).

**Teachers' opinion about students ability to connect their PBL experience in day-today-life**



**Fig.7: Teachers' opinion about students' ability to connect or relate their PBL experience in day-today-life**

Fig.7 shows a positive response of students' ability to connect their learning experiences in their day-today-life, as it is observed from the opinion of the teachers. At least, 50% of the students are able to relate their PBL experience in day today life.

**Table 2: Following are the various types of help students have received in carrying out their PBL activities in Science.**

S.NO	HELP
1.	Study at college relatives to help for field trips
2.	Library
3.	Internet
4.	Pen, Pencil ,Rubber, Scale helps from friends
5.	Teacher's Encouragement
6.	Parent's to help buy a materials
7.	Hard work and self involvement
8.	Teacher's to help field work
9.	Guide teacher of learning
10.	Friends to help field trip
11.	Related with the project persons

**Discussion on Results**

21<sup>st</sup> Century employers are looking for graduates who possess soft skills that include responsibility, self-confidence, social and communication skills, flexibility, team-spiritedness, good work attitude, self-motivation and self-management. Many skills learned through Project-Based Learning (PBL) are highly sought by today's employers including the ability to work well with others, handle interpersonal conflicts, make thoughtful decisions, as well as practice and solve complex problems. It is evident that PBL facilitates the growth of learners in acquiring the 21st century skills (Faridah Musa, *et al.*, 2012). The present study shows that 99% of the students involved in the PBL activity confirmed that it had developed in them the confidence in group work and communication skill. 97% of them think that PBL is helpful in learning science concepts by doing field work and group planning.

Like any approach, PBL is only beneficial when applied successfully. Some of the suggestions received from the teachers are worth mentioning here: PBL is a very good method in science teaching and learning. However, Government should offer funds for field trip and exhibition, special supervisor is needed for PBL activities, more and more trainings should be given to all science teachers. It is required to arrange proper material at the time of PBL implementation and give

sufficient time to learning. A special allocation of block hours is required to be included in the regular time table of the school for effective implementation.

HMs and teachers know the special features of the PBL which are entirely different from the other methods of teaching science, as the latter is the teacher centered whereas the former is fully learner centered. All teachers under study were trained about implementing PBL approach in teaching Science at RIE, NCERT, Mysore. 88% of the schools are of the opinion that PBL approach can improve the quality of Science education.

PBL involves field work where children are encouraged to collect data, information, interactions with experts in relevant fields. Many teachers expressed difficulty in taking the students outside the school premises, as management or parents do not allow doing so. Some time, to avoid formalities, some teachers took students outside for short while. By going outside, regular classes may suffer. However, the present finding reveals that by going outside for field study did not suffer regular classes. 25% of teachers were not sure about the field work hampering the regular classes.

Is PBL possible for all science topics? The answer is simply 'No'. Planning for PBL must take into account what is possible in a classroom. Not all topics are amendable for teaching through the PBL approach. Moreover time factor to transact the topics in the curriculum in a given academic year has to be kept in mind by the teachers. For good education less is more. Teachers have to take a decision as to which topics have to be taught in depth against those which require direct instruction. Hence, in PBL approach, the role of the teachers is to identify topics and select a topic with which students can learn on their own with suitable inputs. Thus PBL is one of the strategies through which learning of science can be made very interesting. Besides, students will be motivated to produce a superior product by facilitating learning.

It may be concluded from the collected data during the field work that the teachers have shown immense interest in implementing PBL approach in their respective schools within a span of one year of training that was given to them. However there are few drawbacks in attaining 100% effectiveness in implementing PBL approach of teaching science due to certain factors such as, parents did not permit their wards to go out for field work, lack of financial support to conduct field activities, teachers lack interdisciplinary approach to carry out projects, activity based learning is time taking process, PBL approach adds more work load for the teachers. All such reasons were found to be stated during the present study.

The outcome of this study comes from four districts of Tamil Nadu, where all the 25 schools under study, are from rural circumstances. The sampling in this study has covered interacting with 1309 students of secondary level (Mostly class IX, few students from classes VI, VII and VIII), 25 trained and implementing teachers and 25 HMs at secondary level. With the new Textbooks that have CCE inbuilt; many teachers are perplexed with the PBL which is totally a new and different approach and the CCE which is evaluation aspect.

From the present study, it is apparent to conclude that PBL method is productively implemented and students of those schools in question have accepted learning of science subject through PBL method. It is also expressed to extend learning of other subjects such as Social Sciences, Language subjects through PBL method.

However, it will be too early to opine that the schools in the entire Tamil Nadu state of India have effectively implemented PBL approach to teaching and learning of science subject. The present study is focused at the trained teachers coming from 4 districts out of total 31 districts of Tamil Nadu state. There is an immense scope to further study the same parameters in other districts of the state in the near future as well as other states of the country. Like any approach, PBL is only beneficial when applied successfully.

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