

## LEARNING BIOLOGY THROUGH PROBLEM BASED LEARNING – PERCEPTION OF STUDENTS

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### ABSTRACT

The study was undertaken to assess the student's perception while learning class 9<sup>th</sup> biology through Problem-Based Learning (PBL) method. Two hundred students of Government School of Chandigarh affiliated to Central Board of Secondary Education (CBSE), New Delhi, India, constituted the sample for the study. Hundred students were randomly assigned to the experimental group while hundred students were randomly assigned to the control group. Both the groups consisted of the students which had average, below average, and high academic achievement. Experimenter did not disturb the normal set up of the classroom in the school while undertaking the study. Both the groups were taught the topics of biology of class 9<sup>th</sup> Science as per science textbook issued by NCERT (National Council for Education, Research, and Training). On completion of the selected topics of biology, students of experimental group were asked to fill the opinnionaire which consisted of 25 items to analyze their perception towards PBL. Percentage technique was employed for analyzing the results. The study revealed that PBL makes learning an enjoyable experience by exploring new knowledge, increasing curiosity amongst the learners, linking previous knowledge, and creating interest.

Keywords: Problem-based Learning, Opinnionaire, Opinion, Perception, Biology.

### INTRODUCTION

India has been constantly showing improved literacy rate since last few decades, but still less emphasis is laid on basic understanding of the topics that are being taught in schools/colleges. As a result, the youth who are professionally qualified, lacks the basic skills to grab a job in the concerned field. The emerging jobs in almost all fields are primarily thinking jobs which require high order intellectual, analytical, and creative skills, and fair amount of problem solving skills. Thus, an individual need to be well versant with practical application and proper understanding of what he/she is learning not only to progress in his/her career but also to be successful in one's field.

In the world of competition, there is an urgent need of replacing the traditional chalk and talk method with the innovative methods which can help the learner not only in better understanding but also in linking what is learned in

school/colleges in real life situations. Although the entry of computers in the field of education has revolutionized the education system but still our teachers lack the spark in actually implementing and teaching by new methods of teaching learning process as they are time consuming and the main focus is to timely complete the syllabus without analyzing how much the students has learned. As a result, some students who have high Intelligence Quotient (IQ) are able to achieve better in the class and the low achievers lack behind. Students with rote memory at times are able to achieve better. Problem based learning is a method which will not only enhance skills like critical thinking; problem solving skills; self directed and self regulated learning skills; reasoning skills; leadership skills; team skills, i.e. learning in groups, cognitive skills, but will also help in better retention of the learned topic and will help the learner to associate the learned topics with

real life situations.

## 1. Problem based Learning

In the last few decades, various developments have increased the momentum of problem based learning which focuses on producing a learner who will not only be capable of remembering the theory, but will also have an understanding of when and how to apply it (Richards & Cameron, 2008) and this, in turn, will help in bridging the gap between theory and practice (Baldwin & McCombs, 2004). Smith and Hung (2017) described PBL as an instructional way by which emphasis is laid on problem-solving and active participation of the students in the pedagogical process to learn the subject. Monrad and Molholt (2017) viewed the problem in PBL acts as a trigger and motivator for learning and discovery and students experience decides what they will learn rather than the tutor dispensing the syllabic content.

## 2. Purpose and Significance of Study

While taking up any research work, opinion, reaction, and perception of the students is an important criterion to check its effectiveness. Although Problem based learning method of teaching has been used in teaching Medical Sciences, Pharmacy, and Engineering in India, there has been negligible research on applicability of PBL at school level. Moreover, education system in India is more exam oriented and less emphasis is laid on the applicability of the subject matter taught. Though applicability of PBL can be studied on any subject, the research on the subject of biology was taken up as it is an important aspect of the child development at school level as it helps in understanding one's own body processes as well as gives a better and a scientific understanding of the living things around them. Biology can be best learned if associated with day to day life and one's surrounding which contributes towards maximum involvement of the child. So, the investigators made an attempt to study the perception of students towards problem based learning strategy in learning biology of 9<sup>th</sup> class.

## 3. Literature Review

Antepohl and Herzig (1999) found that both groups (PBL and traditional lecture group) exhibited similar scores in

the examination that consisted of short-essay and multiple-choice questions with a tendency favoring PBL students for short-essay questions. Students believed PBL to be more effective than the lecture format in terms of using additional learning resources, team work, and inter-disciplinarily learning.

Forbes et al. (2001) explored the perception of undergraduate nursing students towards PBL. The findings indicated that students perceive their learning in the group based teaching (PBL) as effective in focusing their role in the clinical practice environment while lectures and laboratories provided the skills and knowledge required for this setting.

Parikh et al. (2001) regarded individual feedback from the tutor in PBL is helpful. Although peer and group feedback was also preferred by students.

Cooke and Moyle (2002) concluded that PBL approach promotes critical thinking, active participation, and problem solving skills. Learning in PBL is self-directed, realistic, interesting, collaborative, creative, and includes synthesis and integration of wide variety of knowledge.

Pawlak (2002) observed that excitement and participation increased for most students through PBL, but not for all. During the course of the study classroom behavior also improved.

Rideout et al. (2002) compared curriculum of PBL and conventional learning in terms of perception of students towards clinical functioning, clinical practice, and satisfaction in regard to knowledge gained. Students taught through PBL were more satisfied with program outcomes, tutors, level of independence, and assessment.

Antepohl et al. (2003) found graduates, who were taught through PBL, showed a high degree of satisfaction with their undergraduate education in preparing them for medical practice in terms of communicating with the patients, development of critical thinking, and positive scientific attitudes along with collaboration with other health professionals.

Das Carlo et al. (2003) studied perceptions of students about effect of sponging, withdrawal, interaction, motivation, elaboration, and cohesion on group

productivity using a self-administered questionnaire and how cognitive and motivation factors in PBL effects group productivity in males and females.

Abu-Hijleh et al. (2004) used a questionnaire to analyse the feedback and perception of 60 medical students' learning experience of cardiovascular system. Results revealed a positive and significant correlation among integration and knowledge, skills and knowledge, and also between skills and integration indicating a satisfactory learning outcome.

Habib et al. (2006) in a cross-sectional study concluded that PBL session is liked by 79% of medical students and 85% of students were motivated towards self-learning. Students supported PBL as an effective method of learning, in building up communication skills, interpersonal relationship, problem solving capacity, and motivation towards self-learning.

Khaki et al. (2007) found that students taught by PBL method received better examination scores, felt more satisfied with enhanced problem solving abilities than students of traditional teaching.

Murray and Summerlee (2007) showed that the PBL course had very positive effect on the immediate and persistent behaviors of students.

Elsie et al. (2009) in a cross-sectional descriptive study rated PBL as a good instructional method by all the students and 80% of teachers. All the students and the teachers reported that PBL acts as a gateway to the acquisition of key generic skills like team work, problem-solving, and self-directed learning.

Gregson et al. (2010) determined the perception of students towards problem-based learning (PBL) and indicated that the PBL, assignments and post-assignment group discussion helped the students in better understanding of concepts in pharmacology.

Huang (2012) found a majority of students satisfied with PBL but for motivation mixed feelings was discovered in the research. However, the more time taken for studying English by PBL ultimately developed learner's interest in the English language.

Sendag & Duran (2012) compared perception of

instructional activities of 40 pre-service teachers in an online PBL and online instructor-led learning by collecting data through an open-ended survey questionnaire. Findings indicated that the pre-service teachers found the ill-structured problem scenarios encouraging gaining of content knowledge.

Preeti et al. (2013) analyzed student's feedback for two modules of problem based sessions. Feedback from the students revealed that most of the students agreed that PBL helped in creating interest, better understanding of the subjects, and aids in self-directed learning.

Massa et al. (2013) examined student reactions towards PBL in photonics technician education quantitatively and qualitatively to assess student motivation, metacognitive self-regulation, critical thinking, self-efficacy, and peer learning. All variables showed positive gains indicating PBL as an effective strategy in developing the knowledge, skills, and attitudes of photonics technicians.

Surif et al. (2013) studied the level of students' satisfaction towards the use of PBL in their learning. The results showed that PBL enhanced communication skills, collaboration, students' motivation, and independent learning.

Ghimire and Bhandary (2014) studied the perception of medical students on PBL and found positive reaction towards PBL irrespective of gender or educational background. In addition, students agreed that PBL fostered generic skills like communication, group work, critical thinking, reasoning, reflectiveness, and self-directed learning.

Nanda and Manjunatha (2013) evaluated the preference of PBL over traditional lecture method in physiology and found that for most of the items pertaining to student-teacher relationship and learning efficiency, PBL students scored significantly higher.

Shankar and Nandy (2014) studied student feedback about PBL and found PBL as a valid teaching-learning methodology which enhances the understanding of students of difficult concepts.

Othman and Shalaby (2014) studied student's perception and acceptance of PBL approach in critical care nursing practice and revealed positive attitudes of students

towards PBL as it helps in professional knowledge construction, improvement of problem-solving skills, self-directed learning skills, and enriched teamwork experience.

Alkhuwaiter et al. (2016) studied the perception of 240 students in the PBL curriculum. Most of the students reported their ability to speak in front of people, finding information using the internet/library, cooperative and collaborative learning, problem-solving, and decision-making skills are enhanced by PBL.

Warnock and Mohammadi-Aragh (2016) found significant improvements amongst students in their ability in written communication, problem-solving skills, and self-directed learning along with an ability to work in teams and communicate orally through PBL.

Thakur and Dutt (2017a) conducted a study on a sample of 188 students randomly distributed into experimental (n=93, taught through Problem Based Learning (PBL)) and control (n=95, taught through lecture method) group. Both the groups were taught the same topics of biology by the same instructor for a period of 5 weeks. The data was collected via the pre-test and post-test administration of Biology attitude test. The results were statistically analyzed using Statistical Package for the Social Sciences (SPSS) software by employing both descriptive and inferential statistics (t-test). Results indicated that there was no significant difference in attitude of students towards biology taught by Problem based learning and lecture method.

Thakur and Dutt (2017b) in their study indicated that problem based learning positively impacted the achievement motivation of students who were taught class ninth biology by PBL.

Wijnen et al. (2017) reported positive study behaviors, such as regular studying and active involvement of students as a result of PBL. However, dissatisfaction regarding the PBL program amongst staff members and feelings of insufficient preparation for the legal profession was reported by students.

From the review, it can be concluded that in most of the situations learner had a positive perception while learning through problem based learning which enhanced

understanding of the difficult concepts, fosters various generic skills like critical thinking, communication, and soft skills which help in interaction with other people, problem solving skill, collaborative, and self-directed learning. Although student reaction, feedback, opinion, and perception towards problem based learning has been studied in varied conditions and in different disciplines, but reaction of students towards PBL in students of class ninth for the subject of biology has not been studied.

#### 4. Method used for the Study

In the present study, the researcher has conducted an experiment wherein, one group was exposed through PBL and the other by traditional lecture method and administered opinionnaire containing 25 statements at the end of experiment to students in the PBL group to analyze their perceptions towards problem based learning strategy.

#### 5. Population and Sample

Students studying in Class IX, of Government Schools equipped with library, computer laboratory, and science laboratory in Chandigarh affiliated to Central Board of Secondary Education (CBSE) with English as medium of instruction constituted the population of the study. The data was analysed on a sample 93 students who received biology instruction in accordance with the PBL format.

#### 6. Procedure

The study was conducted at the start of new session of 2016-17 when students after passing class 8<sup>th</sup> entered a new class 9<sup>th</sup> and had negligible knowledge about the syllabus of class 9. The duration of the study was 6 weeks from April to May. Six chapters of Class 9 biology was taught namely: The Fundamental Unit of Life, Tissues, Why do we fall ill, Diversity in living organisms, Improvement in food resources, and Natural resources from the prescribed syllabus of 9<sup>th</sup> class. The experimental group was taught by Problem Based Learning method and constituted group of 4 students each. Initially 25 groups constituting 4 students each was formed in two classrooms (n=60 and n=40), but the actual data was

analyzed on a sample of 93 students only. The whole biology syllabus of class 9 which constituted 6 chapters were divided into 25 worksheets.

On completing the whole syllabus, the PBL group was asked to fill the "Problem Based Learning Strategy Opinionnaire". The opinionnaire used four point likert scale ranging from strongly agree to strongly disagree to gather the opinion of the students towards problem based learning. The instructional strategy of problem based learning was evaluated on the basis of variations such as content and level of the modules, positive attitude towards learning, integrating new and old knowledge, understanding of the concepts, principles of self-learning, etc.

### 6.1 Development of Tools

- Problem Based Learning Lesson Plan
- Development of Opinionnaire to study the perceptions of students about the PBL.

Initially, the test had 36 items, but with the help of expert view the items were reduced to 25 items which had a total score of 100. The opinionnaire was designed not only to analyse the opinion of the IX grade students towards problem based learning, but also to find out the effectiveness of problem based learning method. The items were broadly based on the following dimensions as given in Table 1.

### 6.2 Administration and Scoring of the Opinionnaire

Although the present experimental study was conducted for teaching by problem based learning in group of four students each, the opinionnaire was individually administered. Before starting the test, a proper rapport was developed by the investigator and the students were instructed to make a response on every statement by putting a tick mark. The opinionnaire was based on 4-

S. No.	Dimension	Items
1	Experience	1, 4, 17, 20, 24.
2	Environment	3, 5, 22.
3	Learner	6, 11, 14, 16, 19, 21.
4	Knowledge	2, 10, 12, 15, 23, 25.
5	Social Interaction	7, 8, 9, 13, 18.

Table 1. Dimensions for the Opinionnaire towards PBL Strategy

point likert scale categorized as SD- Strongly Disagree, D- Disagree, A- Agree, and SA- Strongly Agree. The scoring of the statements was done as SD-1, D-2, A-3, and SA-4.

### 7. Results and Interpretation

A proper attendance record was maintained by the researcher during the study. The feedback of 93 students who were taught class 9<sup>th</sup> biology by problem based learning method was analyzed using percentage technique.

#### • *Problem based learning makes learning an enjoyable experience*

Majority of the students (93.5%) agreed that PBL makes learning an enjoyable experience and only 6.5% disagreed with the statement. Being a new and an innovative method of learning, initially the students were hesitant and confused too while learning through PBL as the method was something different through which students had learned their various subjects till present. But with passage of time and findings new information related to the topic by the use of Internet, collaborative learning, and constructing their own solutions for the problem lead to an enjoyable experience for the students as well as enhanced creative thinking and problem solving skills.

#### • *Problem based learning helps in discovering new things*

Almost 80.6 percent of the students felt that PBL helped in discovering new things and only 19.4% students disagreed with the statement. Use of Internet and performing experiments in the laboratory while learning through PBL, helped students in understanding the concept of cell structure, tissues, etc. by actually, viewing the things in the animated form which created a lot of interest in the students. Moreover, problems in PBL were ill structured and associated with real life situations which triggered and motivated students at every step to discover something new.

#### • *PBL creates a tension free environment as we can work out beyond the boundaries of classroom environment*

71% students agreed with the statement that PBL creates a tension free environment. During the study,

experimental group was not restricted to classroom alone; instead they were free to use different resources like library, herbal garden, internet, micro-organisms kit to experience things under study. However, 29% students disagreed with the statement which may be attributed to the reason that extra efforts are needed on the part of the learner in solving the problem under study unlike in the traditional method of teaching where students have to just sit and listen passively and teacher just narrates the information.

- ***Challenging atmosphere is created every day***

82.8% students agreed with the statement as a new problem meant a new challenge for them and 17.2% students disagreed with the statement. Problems are the prime source which creates curiosity in students, every day is a new day with new problem and a new challenge. Moreover, the spirit of competition to do better than the other group and to find the best answers for the problem created a challenging atmosphere every day.

- ***It reduces stress in the classroom***

Number of students who felt that PBL reduces stress was only 49.5% which means some students were stressed for doing better than the other. 50.5% felt that PBL leads to stress for achieving better and to find solution to the problem which ultimately leads to better performance. PBL method requires a lot of efforts for research and finding solution for the problem which may have led to stress in the students. Stress cannot be always presumed a negative factor, sometimes positive effects can also be associated with stress which may lead to better and effective results.

- ***This method of teaching has developed self confidence in me***

Self-confidence was built in the students through self-learning and discovering things on their own to which 79.6% students agreed. 20.4% students disagreed to the statement, which may be attributed to the fact that the higher achievement by other students may at times lower the self-confidence of students having lower achievement.

- ***It provides scope for social interaction***

80.0% believed that PBL provides scope for social interaction due to its collaborative approach and 20.0%

disagreed to the statement. As PBL is not a one way process and is mainly based on the principle of discussion and learning amongst peers, it developed self confidence in students who were initially introverted and hardly talked to anyone.

- ***It provides opportunity to share ideas and thoughts***

Majority of students (76.4%) felt that PBL provides opportunity to share ideas and thoughts. However, 23.6% students were in disagreement to the statement which may be due to the short time in which experiment was conducted. Learning in small groups gave an opportunity to the students of experimental group for sharing their thoughts and ideas which are not possible in traditional methods of teaching learning process like lecture method.

- ***It provides better opportunity for discussion in the classroom***

As the solution of the problem is to be discussed in groups and then presented in front of the whole class, so PBL is an effective method which provides better opportunity for discussion in the classroom as agreed by maximum (81.0%) students, whereas 19% did not agree.

- ***It makes learning more meaningful***

Learning is made meaningful due to the fact that PBL associates learning with real life situations which leads to better understanding as well as helps students in finding meaning of what they are learning and why they are learning which was agreed by 86% and disagreed by 14%.

- ***It motivates the student for learning***

Continuous motivation from the teacher and amongst the group, motivated the students on each and every step of PBL which was agreed by maximum (74.2%) students. However, 25.8 disagreed to the statement which may be mainly due to the extra efforts required on the part of the learner.

- ***It provides an opportunity for instant and frequent feedback***

Majority of students (68.8%) agreed to this statement as instant feedback was provided after completion of every problem through discussion in the class as well as by

checking the worksheets submitted by the students. However, 31.2% disagreed to the statement may be due to the reason that the feedback was mainly given in the group and PBL don't provide an individual feedback as in traditional method of teaching like lecture method.

- ***It gives better scope for sharing learning***

Sharing learning is an approach of PBL as information is shared amongst the group and later in the whole class to which 82.8% agreed and 17.2% disagreed.

- ***It creates curiosity among learner***

Curiosity to find solution of the problem as well as to find more information related to the problem created curiosity amongst learner at each and every step of the process which is agreed by maximum number (83.8%) of students, whereas 16.2% did not agree.

- ***This method enables the learner to get in depth knowledge of the subject***

One day, one problem, one worksheet was the concept followed during the experimental study which enabled the learner to get in depth knowledge about the subject as well as the topic related to the problem to which 76.2% students agreed and 23.8% disagreed.

- ***It gives better scope for active involvement of the learner***

71% students agreed to the statement whereas 29% students gave their disagreement. All the students of the group were actively involved in the process of learning as role of writing answers on the worksheet; the role of gathering information, presenting information is assigned to each member of the group which were being rotated for every new problem.

- ***It provides better scope for independent thinking***

Though maximum students (65.6%) agreed with the statement, but there were still few (34.4%) who felt that independent thinking at times was suppressed due to working in groups.

- ***This method provides opportunity for better interaction in the classroom***

Majority of the students (76.3%) agreed that PBL provides better opportunity for interaction in the classroom due

collaborative nature of PBL. Only 23.7% did not agree to the statement.

- ***This method has improved my communication skills***

Maximum students (76.4%) agreed that PBL improved communication skills while presenting solution to the problem in front of the whole class. However, 23.6% students gave their disagreement.

- ***It has developed positive attitude towards learning***

Learning through new method, i.e. PBL which made students walk out of the four walls of the classroom created a positive attitude towards learning amongst students to which 82.8% students agreed and 17.2% students did not agree.

- ***It has developed my decision making skill***

Decision making skills were developed as self-learning and discussion amongst peers built self confidence in students which lead to improvement in decision making skill of the students to 78.5% students agreed and 21.5% disagreed.

- ***It provides better scope for more student involvement in teaching learning process***

PBL is a student-centered instructional strategy where student plays an active role by involving students to the maximum extent to which majority of the students (72.2%) agreed and 27.8% students gave their disagreement.

- ***It enabled me to gather more information about the topic***

73.4% students agreed to the statement, but 26.6% students did not agree with the statement. PBL in the present study was not limited to textbooks only; instead students were free to use varied resources available in the school for finding solution of the problem.

- ***It creates interest in learning***

Most of the students (71.0%) agreed that the PBL method creates interest in learning due to maximum involvement of the students. However, 29.0% students did not agree may be due to the extra efforts needed on the part of the learner.

- ***It helps in linking previous knowledge with current knowledge***

Maximum students (88.2%) agreed with the statement as

the topics chosen for the study were linked to the topics the students had studied in the lower classes and only 11.8% students gave their disagreement.

## Conclusion

From the responses, it can be inferred that maximum percentage of student's favoured problem based learning while learning the subject of biology in comparison to traditional method of learning. Majority of students had found problem based learning an enjoyable experience because students learned at their own pace without any restrictions and by exploring new avenues for gaining knowledge by solving realistic problems. PBL helped students in discovering new things besides the syllabus prescribed in the textbook by creating a tension free environment and challenging atmosphere, which enhanced self-confidence, independent thinking, curiosity, and motivation of students through social interaction, sharing ideas, and thoughts. Various skills like independent learning, communication skills, decision making skills, attitude towards learning were also improved while learning biology of class ninth in both male and female students. The findings of the study can be linked to the research done by Antepohl and Herzig (1999) who found that PBL is an effective method for inter-disciplinarily and additional learning resources and team work, Cooke and Moyle (2002) found PBL to be realistic and interesting, Rideout et al. (2002) and Antepohl et al. (2003) reported high satisfaction amongst students of PBL, Alkhuwaiter et al. (2016) and Warnock and Mohammadi-Aragh (2016) described that PBL enhanced cooperative and collaborative learning, problem-solving and decision-making skills, ability to speak in front of people and in finding information using the internet/library. Wijnen et al. (2017) in their research established positive study behavior in students taught through PBL. Chauhan (2017) concluded that PBL has great impact on the performance of students along with enhancement of problem solving, high order thinking skills, logical reasoning, creative thinking, motivation, soft skills, cognitive, and practical skills which is required by an individual in day to day life and at the workplace. Thakur et

al. (2018) has critically reviewed the studies related to development of skills through Problem Based Learning and concluded that problem based learning is based on both collaborative and constructive principle, which can enhance various skills in the students like: creative thinking and reasoning, decision making, leadership, scientific, communication, self regulated learning, Problem Solving, and team skills. Thus, all research studies have reported a positive perception of students towards problem based learning instructional strategy.

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