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Perceiving the Suitability of Adopting Problem Based Learning Pedagogy for Technical Education Entrants

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Abstract: During campus Interviews, the student's cognition is the Employers desideratum. They have incertitude regarding the same due to the scholastic system which is exam-oriented. It thus is an obligation on the teacher's part to ascertain that students get more proactive during the classroom sessions. Problem-based learning (PBL) could be an effective alternative tool for boosting their interest and involvement in technical education. As Symbiosis Institute of Technology is an autonomous body, the freedom of adopting a different teaching method was used. In this study, the first week of the academic semester was converted into a week full of PBL activities instead of regular classes on a cohort of students from diverse background. This was done to understand if students could apply pre-requisite knowledge that they gained through regular tutelage. To test the usefulness of the concept of PBL in technical education, few activities were planned to introduce students to new concepts allied with the course structure of that semester. The study showed that students had limitations in the application of prerequisite knowledge and 10% could solve the problem completely. 62% of students were successful in doing new tasks using the PBL technique. 8% of students were able to reach to correct solution. Thus, student engagement can be boosted by the use of PBL pedagogy in technical education.

Keywords: Problem-based learning, Technical Education, Engineering, Employability.

1. Introduction

India is undergoing a transition in education quality, due to the guidelines provided by All India council of Technical Education (AICTE). The faculty of Engineering are getting exposure to quality research and thereby are able to perform as better facilitators in classroom. However, a general perception of Engineering Faculty regarding the students in class is that they lose interest in classroom discussions frequently. They refrain from taking down notes in class. This could be due to the belief that easy availability of the internet makes them omniscient. Ultimately they have a tendency to cram for final examinations. This leads a student to become exam-oriented rather than being inquisitive. This abates the quintessence of technical education which aims them to have finesse in technical know-how and clear Engineering basics. Problem based learning is a proven pedagogy which engages students in an active learning environment. It is also evident that a teachers would require training which is quintessential for success of the pedagogy in general.

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2. Literature Review

Many educational initiatives worldwide have emerged in recent years to enhance student learning motivation, facilitate student engagement in the learning process, and produce more competent graduates (De Graaff, E., &Cowdroy, R. 1997, Bowe, Brian 2007, Wang, G., Tai B., & Huang, C. et al. 2008.). Constructive alignment is an approach to design a curriculum that optimizes the conditions for quality learning (Biggs, J 2003).student as one who constructs meaning through relevant learning activities; thus, what the student does is important. 'alignment' refers to what the teacher does is to provide a learning environment that supports the learning activities appropriate for achieving the desired learning outcomes (Lee Hong Sharon Yam and Peter Rossini. 2010).It is a student-centered approach that engages students in exploring important and meaningful questions through a series of investigations and collaborations (Krajcik, JS, Czerniak, CM & Berger, CF. 1999)To what extent teachers should give students learning autonomy is dependent on the context. To build up a student-centered learning approach such as PBL, educational practitioners do not only need to transform teachers' perceptions of their role and student learning autonomy (Huichun Li and Xiangyun Du. 2015). The majority of students who graduate from professional institutions and engineering colleges are not employable. In India, the problem is that employability and not that unemployment(Sunita Vijay Kumar,2016).PBL also would boost the employability skills of Engineering students(Othman, H, Mat Daud, K. A, Ewon, U, Mohd Salleh, B, Omar, N. H, Abd Baser, J, Ismail, M. E. &Sulaiman, A. 2017). Developing nations face challenges in the process of change. In the absence of necessary infrastructure and support for the adoption of the PBL approach, it is necessary to see student's preparedness for the change.

In regular classroom sessions, it is usually observed that students attempt for home/classroom assignments with acquiesce; however, PBL activities shall make them ardent. Chinese philosopher and reformer Confucius stated in 479 BC – “I hear and I forget. I see and I remember. I do and I understand”. This implies perfectly the axiom of the PBL approach. An effort to test the capability of students to undergo the same was done. PBL has now become a buzz word of current time and is being used in traditional and advanced forms based on experience of the facilitator. But, to assess if the present generation of Engineering entrants, who have studied until highschool with traditional system are ready for the shift in education style, this study gave some important insights. As the study was undertaken in a University-led Institute, the teacher's enthusiasm and capability of undertaking PBL without any formal training were also noted.

3. Design Approach

For the application of PBL in Engineering from initial Engineering years, it is necessary to know student's capability to undergo the same. In this study,

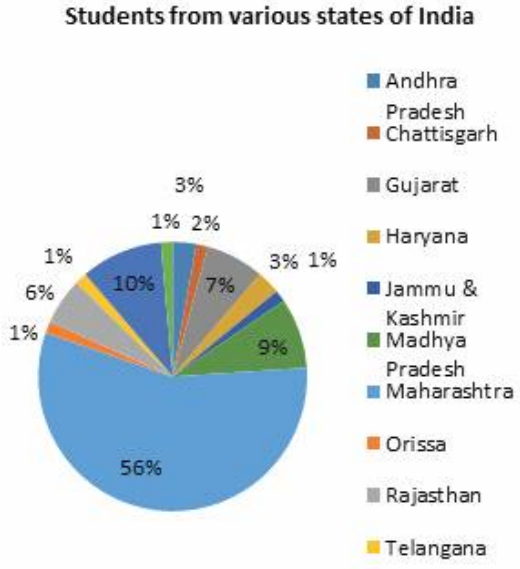


Fig. 1: Student diversity (States of India)

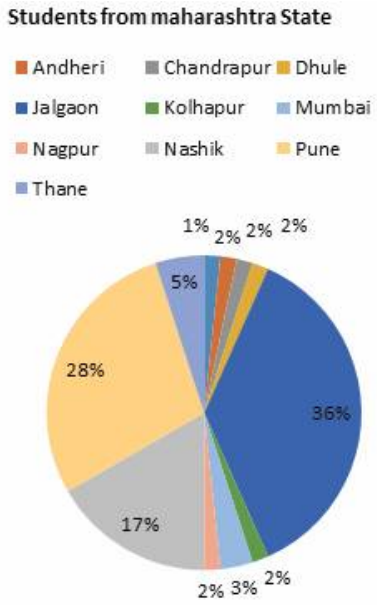


Fig.2: Student diversity (cities of Maharashtra state)

the students which hailed from routine teaching-learning backgrounds were provided with engaging assignments designed in a problem-based learning fashion. The group selected was the class of second-year Civil Engineering. These students had learned interdisciplinary subjects in the first year of their engineering graduate program. A 1-week schedule was devoted to this assignment at the beginning of the semester. The students of the batch were from diverse backgrounds, from across 6 states and 38 cities of India. Figure 1 shows the variations of the batch. India is a culturally diverse country, students from different cities come from a different schooling backgrounds and hence develop a different learning style. The majority of the batch was from the state the University is located in but again, across 11 different cities as shown in Figure 2. Some of the tasks were designed to assess if students could apply the basic knowledge that they had received in early sciences in educational life, given their diverse backgrounds.

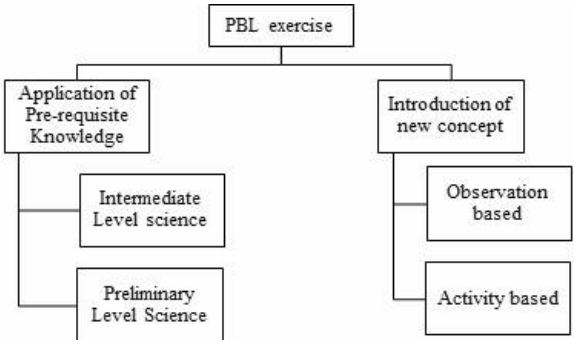
Some tasks were designed to introduce them to certain concepts which were part of their curriculum in the second year. The teachers conducted several meetings and brainstorming sessions for constructing the PBL week. The exercises were planned after several rounds of teeming ideas and discussions. Once the type of exercise was abstracted, the discussions were then turned to framing the exercises in a casual/interesting way so that the student takes it up extemporarily. The teacher's group was asked to be focused more on the end solution required from each student group and thus frame the problem statement. This helped them to design the problems effectively. The total number of students in the study was 72. Teachers decided to divide the students into a group of 4, each group designated alphabetically (A to M) refer Table 1.

Half of the group were engaged in software training sessions synchronously. This made the faculty supervision less tedious. The exercises were broadly categorized into 2 major parts. The first was to assess the student's ability to apply pre-requisite knowledge to obtain solutions and the second to ascertain if students could grasp a new concept using PBL methodology. All the students were given freedom of resources and a deadline to complete their work. The main aim was to see if students could think about the use of a variety of methods to reach solutions. The final successful outcome in the activities was not expected from the students; however, their thought process and involvement were judged.

Table 1 : Group swapping along available venues

Timing	Venue Lab 1	Venue Lab 2	Venue Lab 3	Venue Lab 4	Venue Lab 5	Venue Computer Lab
9:45 AM to 10:45 AM	A, B	C, D	E, F	G, H	I	Groups J to M to be engaged in software training
10:45 AM to 11:45 AM	I	A, B	C, D	E, F	G, H	
11:45 AM to 12:45 PM	G, H	I	A, B	C, D	E, F	
Lunch break						
1:30 PM to 2:30 PM	E, F	G, H	I	A, B	C, D	
2:30 PM to 3:30 PM	C, D	E, F	G, H	I	A, B	

Fig.3: Activity chart for PBL for second-year civil engineering students



Problem statements are attached in Annexure A and B. Students had to submit a report of their work after completion of the activity. For enhancing their report writing skills, they were not forced for immediate submission by the provision of an indulgent deadline.

4. Method of evaluation

Teachers evaluated the students on a Likert scale of 5 with 3 evaluation parameters viz. group work, report generation, the content of the report. Orchestrated Supervision with only two rounds by the supervisor teachers was conducted. This helped in understanding how cohesively they were performing as a group. Freedom of choice of resources was given. The scale of 5 indicated excellent as in students who could complete the tasks in right procedure and yielded correct solution of the problem given.4 number was given to students who could understand the methodology of performance of tasks however did not achieve complete solutions. 3 marks were given to students who could fairly understand the methodology and those who gave a good attempt for it.2were assigned to students who attempted the exercise however failed in understanding the gist. Students whofailed toattempt thetasks were rated as 1.

5. Results and Discussion:

Using the Likert scale, the first observation shows that the students performed fairly when they had to apply pre-requisite science knowledge to solve problems. 15% of the students could not apply the logic at all and none could excel in the activities.

The supervisors noted that none of the students failed to perform the activity using the PBL approach to the said activities and 10% could solve the problem completely. Figure 5 shows that above 60% of students were successful in doing new tasks using the PBL technique.8% of students were able to reach to correct solution It was also observed that students are more successful in activity-based problem. The latter activities involved applying pre-requisite knowledge they gained in early science education, on average 40% of students could perform it efficiently but did not get the correct solution. In these activities, success is considered as good and above as shown in figure no.5.

The student's feedback was taken post submission of the report. They acknowledged overall PBL activity as cogent for understanding the concepts. They appreciated the efforts of the teachers for the same. Overall, they found exuberance in solving activities.

Figure 4 shows result variation for the Likert scale classified based on the degree of activity. It is observed that the students were good in almost all tasks. This may be due to the degree of engagement that the pedagogy provides. A group may have score less in one of the modules but has scored in another one. Thus, the student cohort cannot be directly classified as successful or unsuccessful. This is due to the major advantage of problem-based learning is that all student learning styles get a benefit to be showcased and utilized during the activity course. Thus the marks distribution according to the activity type got a spike in one activity type and low in another.

It was a unique experience for the assistant professors of the department, who had to workgroups for the formulation of the activities. This one-week activity was project-based training for all teachers to get oriented to be able to infuse problem-based earning in routine curriculum and to introduce them to a new role of facilitator. The major issue that they had to tackle was to control the urge of tutelage. The language of the task was framed by finesse to keep up the interest of students. This way the passive student

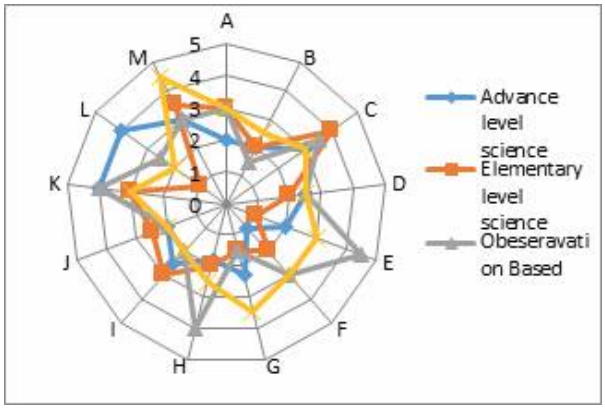


Fig. 4 : Assessment of activity using Likert scale

also found it interesting to give in his share of a task in Group work. The teachers noted by the observation that student's enthusiasm was higher in activity-based assignments. They were performing together as a coterie. It was noted that students needed time to understand the use of simple logic to solve problems.

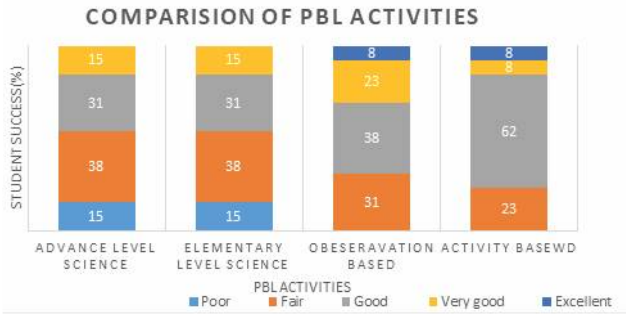


Fig. 5 : Comparison of PBL activities

6. Future Trends

The student group gets well oriented by the PBL activity, and hence, during the induction schedule, every Institute can add the element of PBL for the incoming batch. It is possible to make an alteration of 1 week in a regular teaching-learning system, wherein many hands-on activities can be designed for the students.

7. Conclusion

Embedding PBL in the regular teaching-learning system is not possible completely because of the rules and norms by state universities. However, universities that are private/ state or even government (autonomous) can take advantage of the PBL by implementing it on a very small scale in the form of 1-week PBL activities. The facilitators were zealous in using the PBL approach to introduce the students to a

technical concept. During their supervision rounds, they found it difficult to control the urge of abetment which is essential of PBL. This can be soothed with training. If the construction of a problem statement is lucid then students' interest is coped up. In this activity, the design of the problem statement was made such that students find it intriguing as well as fascinating. Since the concept is new for teachers as well, they had to do contemplate in group discussions to come up with those efficacious problem

statements. The essence of PBL activities requires fresh ideas and thoughtful construction of a problem statement, hence the teachers also had to brush up their basics and upgrade their creative ability. The teachers found the method promising and expressed a desire to cultivate it in regular classroom sessions.

The performance of students was extemporary. The feedback by students states that by the PBL technique they understood that every problem can have a logical thought process for solving it. This exercise proved to be lucrative for boosting student's interest in learning. The students who otherwise were not proactive in classroom teaching sessions were observed to be honchoed in the activities.

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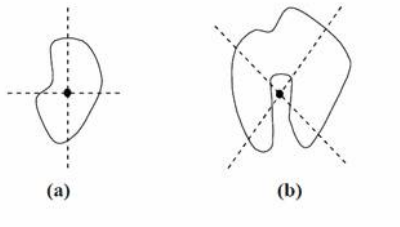
Appendix

Exercise 1 **The Modern Sudarshan Chakra**
(using pre-requisite knowledge)

Prologue *- Lord Krishna is a God in Hinduism who is depicted holding a weapon known as the " Sudarshan Chakra". He keeps rotating it on his forefinger until releasing it for defeating demons.*

Lord Krishna thought of rewarding all Symbiosis Civil Dept students. So, he first thought of giving you practice by providing irregular laminas to see whether you can balance it on a fingertip or not.

Can you find out the point at which it can be balanced?



Equipment/ Materials from the almighty

- cardboards/ thermocol sheets of different shapes
- Thread
- Nail/big needle
- pencil
- rule/straight edge
- Balancing pointer
- load (e.g. stone, wood, screws, etc)

Other requirements

Notebook, pencil, pens for recording

What are you thinking? What have you found? *After completion of the activity student's work was checked and then the following sheet was handed over to them.*

……

1. Explain the center of gravity of an object.
2. List the steps involved in determining the center of gravity of an irregular lamina.
3. If you are given cardboard in a shape of a trapezium, how would you determine its center of gravity?
4. What precautions would you take to ensure good results?
5. Is there any change in the location of the center of gravity if we change the material to have the same shape?

Concept Used: Center of Gravity

Exercise 2: The Forensic expert
(using pre-requisite knowledge)

We all have seen the movie Titanic. You are appointed as an expert for redesigning the Titanic ship using various materials for which you have to undergo some lab tests. Find out the factors which affect floating and sinking.

1. Predict whether the following material will sink or float. (*Tick mark in the appropriate column*)

Sr. No.	Object Name	Float	Sink
1			
2			
3			
4			
5			

2. Apply basic concepts to find out the weight of the immersed object.

3. If there are two blocks of wood having
   a. 2 kg weight and $3m^3$ volume
   b. 8 kg weight and $15m^3$ volume

In which case more possibility is there for floating and why?

4. If two blocks having the same size (equal volume and weight) kept into two different tanks having
   a. Freshwater
   b. Saltier water

In which case more possibility is there for floating and why?

The c oncept used : Students were expected to apply Archimedes principle

Exercise 3 The Perfect Soil For Garden
(New Concept)

Palm Island in Dubai is an engineering marvel. The artificial island is constructed using sand. On a premium villa project in the island, you are appointed as expertise for the landscaping project, wherein you have to decide the type of soil which is best to transport water from ground level to roots.

Take the soil samples provided and find its water - retaining capacity using given materials

Hint: Find the amount of water absorbed by the soil

Record your readings by constructing a proper observation table

Questions:

- What property of soil have you found out?

……

- Calculate the amount of empty space in the sample

……

- Which particle size had the most amounts of voids?

……

- The least amount of space? Was there a pattern to your data?

……

- Does this reveal any relationship between particles size and voids?

……

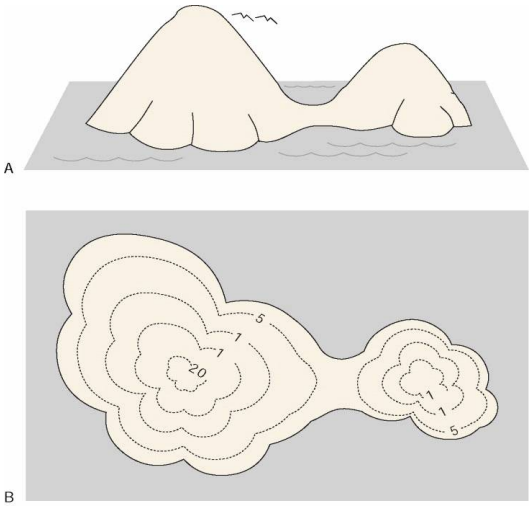
Concept learnt --*With this assignment, students were expected to understand water retaining capacity of the soil and thus to lead them to understand "porosity"*

Exercise 4: Civil Landscaper

(New Concept)

Only Almighty could create the world! Here is an opportunity for you. Only that you shall play the role of Lord Civil! In this exercise, You will be creating a 2D mini earth on paper in the form of its contour map by using 3D clay models.

What's a contour map? Let's start with the word "contour." A contour is a line that shows the border or outline of an object. A contour map is a 2 -dimensional drawing of land. The map includes contour lines to show changes in the elevation of the land. Here is an example



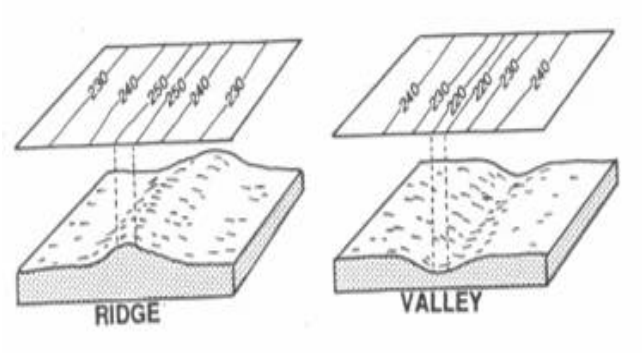
Each contour line shows all connected land that is at the same elevation. Contour lines may be drawn at every 1 - meter difference in height, every 10 -meter difference in height, or at some other scale, depending on the terrain being mapped. The clo ser the lines are to each other, the steeper the terrain.

In this project, you will be making a map that is model - sized. That means you are using a scale of 1:1. 1 cm on the map represents one cm of distance on the model. Take a suitable contour interval. You may want to change the interval depending upon its steepness

Make multiple contour map on the same piece of paper showing at least 5 topographical features out of Hill, valley, river, slope, lake, steep rock edge, Ghat, highway, etc

Tip: First make a ll features using clay and decide their position. Now, Slice the individual feature as shown in the image above. Trace the contour (border) and note down the distance of that slice base from your datum (a piece of paper). Write that number along the contour lines as shown in the figure

Follow this questionnaire once your project is ready



Questionnaire

State True or False - Topographic maps display the three-dimensional characteristics of terrain on a two-dimensional surface.

.....

Tell 1 prominent feature of a contour line

.....

What are your observations regarding the variation of the contour map for various features

.....

.Let's say you want to create a map of a real-world feature, like a portion of the China wall. It may be 5000 feet wide. If you want your contour map to fit on a piece of 50 x 120 cm paper, what scale might you use?

.....

Observe the images and match the pairs