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An Effective Way of Implementing Experiential Learning for Laboratory Courses – A Case Study

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***Abstract*— An effective teaching provides the power of education to the students, thus giving them the possibility suggested by NEP-2020 is a better future. One of the challenges that is faced in this is to link the classroom teaching to a real-world scenario and thus making teaching more effective and relevant. An Experiential Learning, is a dynamic classroom approach, presents a possible alternative to memorization techniques. In this approach, students take responsibility for their learning by acquiring deeper knowledge about the subject matter through active exploration of real-world challenges and problems. This makes the students independent learners as they work for an extended period of time to investigate and respond to a complex question, challenge, or problem. In this regard, Department has introduced the problem-based learning in some its courses. This paper presents a problem-based learning practiced for the course "Object Oriented Programming" for fourth semester UG students as a case study.**

***Keywords*—Experiential Learning; Higher Education Institutes (HEIs); NEP-2020; Outcome Based Education (OBE); Problem based Learning; Project based Learning.**

***JEET Category*—Practice**

I. INTRODUCTION

THE traditional education system has a uniform instructional structure wherein teaching is educator-centric, and the effectiveness of the learning depends solely on them. The main aim of this system is to score good marks in the examination but giving less importance to making the students skilled or knowledgeable enough. Thus, there is a need of paradigm shift in the education system and the focus needs to move from theoretical readiness to practical readiness.

The education system is more successful when it follows Swami Vivekananda's statement *"Knowledge can be got in one way; the way of experience, there is no other way".* Education must move towards less content, and more experiential learning. In this regard our education policy must focus on – 'how to think critically and solve problems', 'how to be creative', and 'how to innovate and adapt'. Pedagogy must evolve to make education more experiential, Integrated, flexible, learner-centered, and discussion-based and at the same time prepare them for gainful, fulfilling employment.

The experiential learning can be practiced at each Higher Engineering Institute (HEI) in three different ways:

i. Problem Solving based Learning (PrBL)
ii. Project Based learning (PBL)
iii. Design Thinking-level Based Learning (DBL)

i. Problem solving based learning (PrBL)

In the traditional approach, the students are taught relevant materials through different teaching aids and students then apply the knowledge to solve problems. Whereas in PrBL, the students learn the course along with the problem solving. PrBL assignments can be short, often group-oriented, so it is beneficial to set aside classroom time to prepare students to work in groups and to allow them to engage in their PrBL project. It is a student-centered approach where students learn about a course by working in teams to solve an open-ended problem. The teaching methodology followed in PrBL is shown in Figure-1.

ii. Project based learning (PBL)

PBL is an instructional approach where students learn a course by applying theories and procedures in solving real-life problems through course-specific projects. PBL presents opportunities for deeper learning in the context and for the development of skills like – teamwork, planning, critical thinking, reasoning, creativity, personal and social responsibility, and life-long learning. The teaching methodology in PBL is shown in Figure-2.

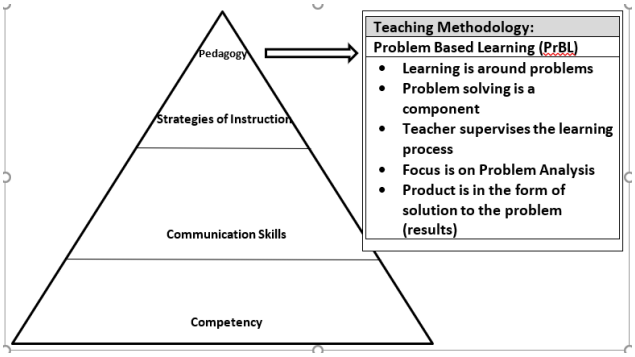

Fig.1. Teaching methodology in PrBL

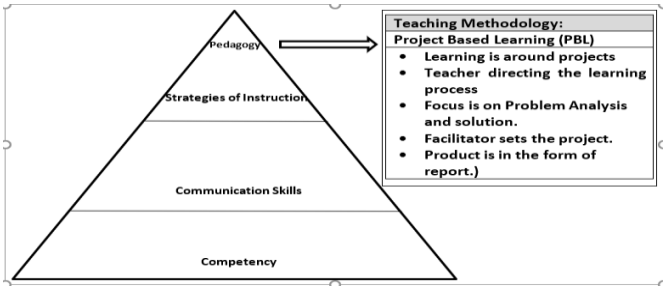

Fig.2. Teaching methodology in PBL

iii. *Design thinking level-based learning (DBL)*

DBL is a way to define and solve tough challenges. It focuses mainly on rapid prototype solutions and learning from mistakes. In HEIs, a design thinking curriculum engages students and teachers in real-world problem solving. The teaching methodology followed in DBL is shown in Figure-3.

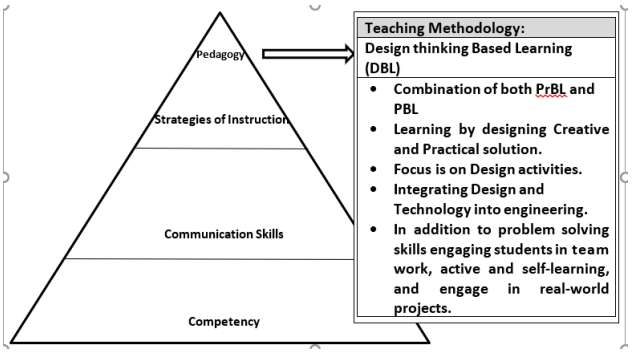

Fig.3. Teaching methodology in DBL

Hence in experiential learning, students were given a real or hypothetical challenge, and employ inductive reasoning to gain knowledge of the subject and develop critical thinking skills. It promotes self-directed learning through the exploration of complex, open-ended problems as opposed to passively taking in lectures or even being guided through the Socratic style of teaching through questions and answers.

The department has implemented PrBL for the course "Object Oriented Programming" for fourth semester UG students and project-based learning for the course "Natural Language Processing and Text Mining" for second semester PG students. The remaining part of this paper presents sample PBL activities by taking these as case studies.

II. METHODOLOGY

The traditional way of conducting a laboratory course lack the following aspects:

1. Complexity in system understanding
2. Open-source reference and therefore self-learning drive
3. Confidence level to face interview and therefore industry relevance.

NEP-2020 has suggested experiential learning drive as a wrapper terminology for the OBE theory suggested by various accreditation agencies in India and abroad [1, 2].

To realize experiential learning of NEP-2020 and to enhance industry acceptance following two case studies were identified and 4th semester Undergraduate level with an intake of 120 students in a course Object Oriented Programming (OOP), one of the essential courses relevant to the basic concepts necessary for all graduates in IT domain-

Case study-1: Design and Development of experiments to enhance primitive design-thinking at entry-level to the program

Case study-2: A multi-part interactive and Open book laboratory assessment.

Case study-1: Design and Development of experiments to enhance primitive design-thinking at entry-level to the program

Decades of experience of the author about student preparation towards industry readiness lacks in the following 6 major concerns-

Concern 1: Visualizing requirements from total system perspective.

Concern 2: Translating requirement specification into system design

Concern 3: Use of standard notation and procedures in design and development of system.

Concern 4: Building robust code and therefore need for Test Driven Development (TDD)

Concern 5: Collaborative Working in a group

Concern 6: Report writing and professional presentation techniques.

Once students are prepared for the above-mentioned concerns at the entry level itself, then learning any subsequent courses including trending and advanced courses go on the right track, thus enhancing industry readiness and therefore improves placement both in terms of quality and quantity. This will also enable the self-learning attribute of a graduate at higher semester level leading to beyond curriculum and also certifications which is the order of the day.

The related problem statements for the experiments are shown in Annexure-I. The 4th semester students of CSE branch gone through this and found that 90% of 120 students were found comfortable in visualizing the subsequent term works. To test the real impact of this on students' learning, an open book lab test was conducted and its process is discussed in Case study-2 [3].

Case study-2: A Multi-part Open book interactive Laboratory test

All 120 students who were part of case study-1 were made to go through this assessment tool. The important features of this assessment are:

- Multi-part
- Open book
- Interactive
- Group work

Multi-part includes identification of OOP concepts and writing design for the problem statement and the duration allotted was 2 hours. Then they were given a 48 hours duration for implementation of the design using Java code which is followed by report submission through detailed interaction with each group of students during the submission process.

This work includes sharing concepts and peer learning enabling moderate level students to get hand holding from creamy layer students. This proved to be better by the satisfaction in learning compared to just normal flow of lab conduction and evaluation. Open book nature enables students to refer various sources of knowledge and understand better way of writing code, newer concepts and trigger learning new connected topics. All students go through viva-voce kind of

assessment, so they are surely be an active contributor for the system that they are demonstrating. This avoids the very trend of copy-submit type of learning.

Group work was not directly scripted in this activity as it was an individual work unlike course group project. However, they were allowed to take help from their peers through dialog and discussions.

Question paper for this assessment is shown in Annexure-II. 91 out of 120 students participated in the feedback process and satisfaction level in their learning is around 95%. The feedback form and students' response summary are shown in the further Results section.

III. RESULTS

The type of assessment done for the laboratory was the first of its kind in our laboratory course conduction. Hence, its related opinions from students were needed for the appropriate follow-ups in the coming up semesters. So, related feedback was taken and its screenshots are as shown in Figure-4 to Figure-8.

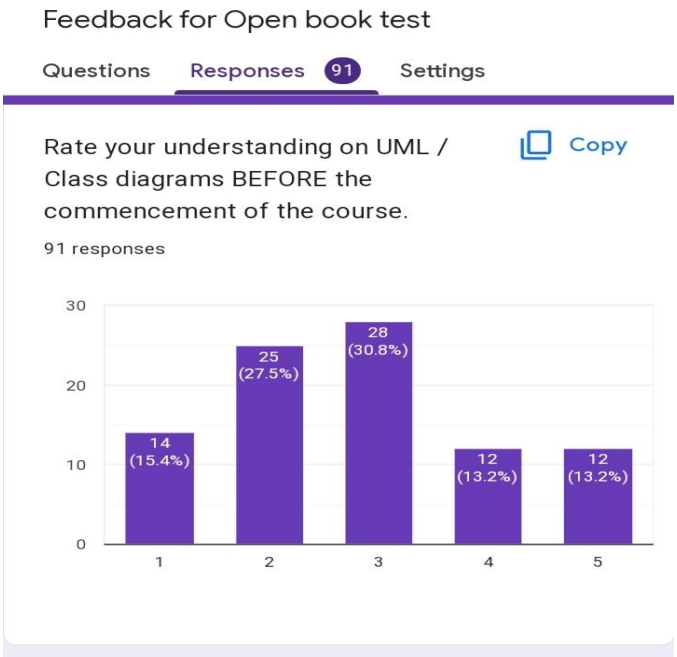

Fig.4. Feedback screenshot1

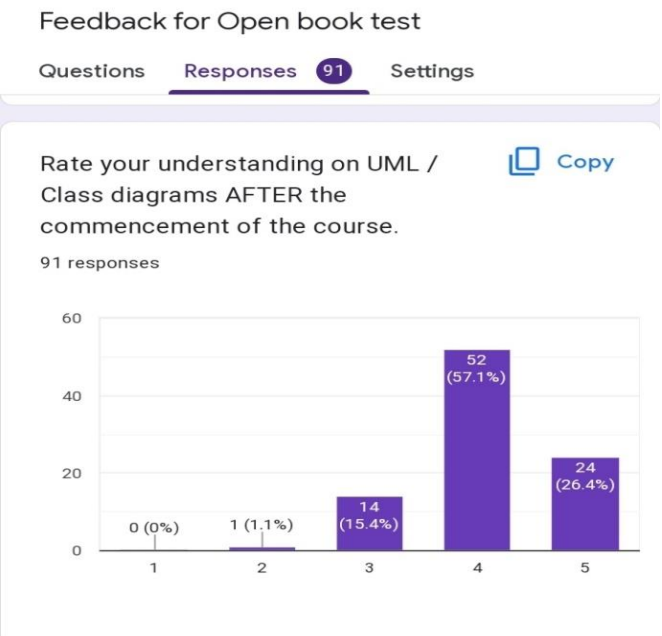

Fig.5. Feedback screenshot2

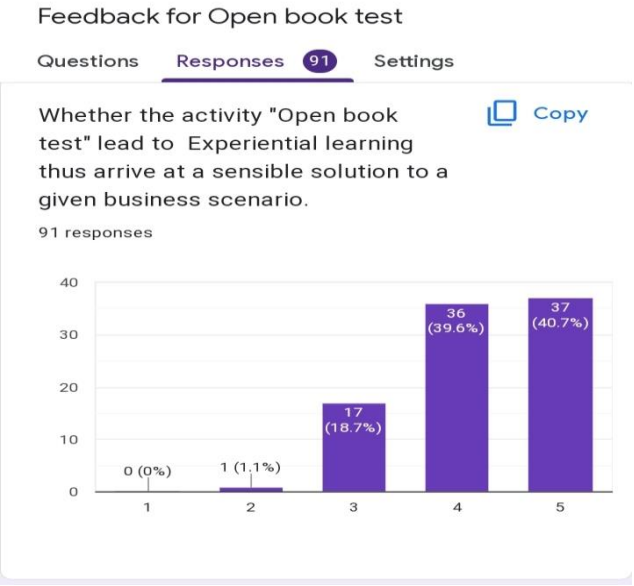

Fig.6. Feedback screenshot3

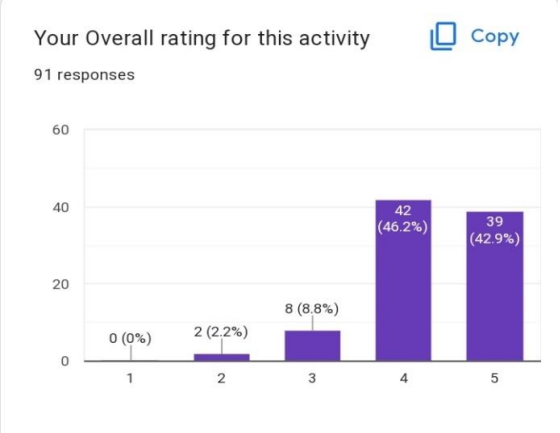

Fig.7. Feedback screenshot4

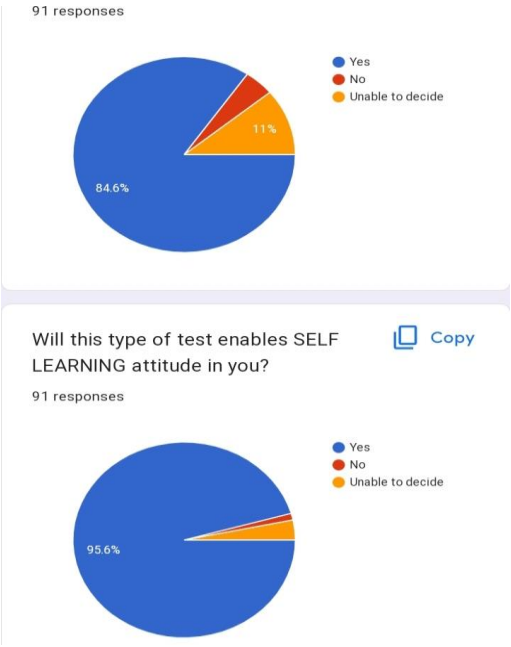

Fig.8. Feedback screenshot showing percentage of agreement for the conduction of open book test

IV. CONCLUSION

Experiential learning suggested in NEP-2020 is an important concept in making students industry ready. This type of learning environment will replace all traditional way of conducting laboratory courses and theory classes. The activities presented in this paper are significant and show learning usefulness index of 95%.

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APPENDIX

1. **Problem Statement:** Write a Java program to solve the below given requirement using object-oriented approach:

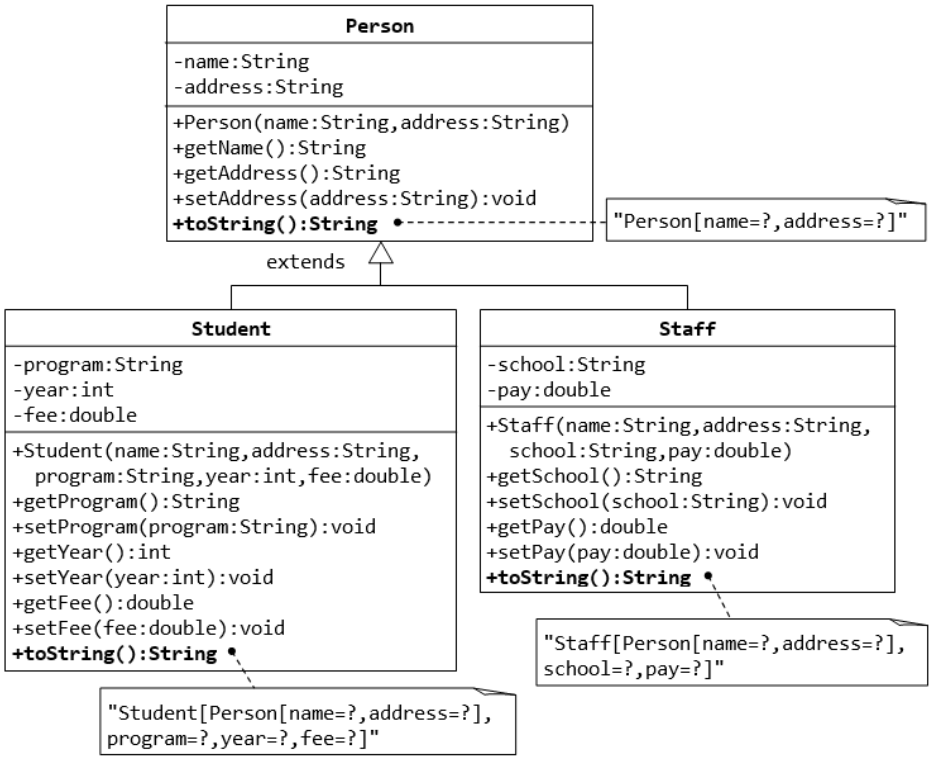
   You are asked to write a discount system for a beauty salon, which provides services and sells beauty products. It offers 3 types of memberships: Premium, Gold and Silver. Premium, gold and silver members receive a discount of 20%, 15%, and 10%, respectively, for all services provided. Customers without membership receive no discount. All members receive a flat 10% discount on products purchased. Your system shall consist of three classes: Customer, Discount and Visit. It shall compute the total bill if a customer purchase ₹x of products and ₹y of services, for a visit.

   CO: 1, 2

   Objectives:
   - Understand given system requirements.
   - Visualize incompleteness in requirement specifications and prepare complete features.
   - Prepare independent stories to enable design and code development and write test scripts.

2. Write a Java program to solve the below given requirement using object-oriented approach.

   CO: 1, 2



   Objectives:
   - Understand standard tools (UML).
   - Do reverse engineering to prepare system requirements from the given design.
   - Finally write code for the given design.

APPENDIX-II

Note:

1. 3 to 5pm on 20-5-2022 - **Design and Writing code on paper**.
2. 6pm on 20-5-2022 to 9am on 21-5-2022 - **Coding**.
3. **Submission** of print copy of code written at 10 am on 21-05-2022.
4. **Evaluation** in regular laboratory through interaction with individual students keeping write-up as baseline.
5. **Robust code, readable code and proper documentation** along with line numbers for every line of code is expected.
6. **Test cases** containing all possible scenarios for all use-cases are mandatory.

PROBLEM STATEMENT:

You are asked to develop a software system to automate day-today operations of a company which contains several departments. Each department has a unique name, a unique number, and a particular employee is designated as manages the department, i.e., a role called manager. A department controls a number of projects, each of which has a unique name, and a single location. Record of each employee i.e. their name, social security number (SSN, which is employee ID), address, salary, gender, and birth date are to be stored and modified on request, approved by the concerned authority. An employee is assigned to one department and work on several projects, which are not necessarily controlled by the same department. Software is supposed to keep track of the following:

- Start date when the employee began managing the department.
- Number of hours per week that an employee works on each project.
- Direct supervisor of each employee.
- Dependents of each employee for insurance purposes. For this we maintain dependent's first name, gender, birth date, and relationship to the employee.

Do the following:

1) **Prepare** the class diagram. – 5 Marks.
2) **List** the various OOP features used with **justification** for their usage.- 2 Marks.
3) **Write** a complete Java program to implement the design with following use-cases
    a) Register and Unregister Employees.
    b) Register and Unregister Projects.
    c) Assign/withdraw Projects to the departments.
    d) Assign/withdraw projects to employees.
    e) Print project details and employee details.
    f) Other tracking activities mentioned above. 6 x 2 Marks = 12 Marks
4) **Write** a short note on the various quality parameters of the code written.-3 Marks
5) **Prepare** test cases. - 3 Marks.

Note: Suitable assumption can be made, if required, for the business case described above.