

Integrating Blended Active Teaching Learning Approach for DBMS Lab Course

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Abstract— Data centralization, effective data management, and data access for application programs are all made simple by organizations by the database management system (DBMS) software. The role of DBMS is to provide an interface between physical data files and application programs. The use of the DBMS in the development of major applications and systems is essential. Currently, a number of big companies, nationally as well as globally, use databases as a backup for their application systems. Many highly well-known DBMS exist, including Oracle, Microsoft SQL Server, MySQL, PostgreSQL, Microsoft Access, IBM DB2, and many others. This paper aimed to evaluate Project based learning, WRITE Method, Concept Map and use of online tools like innovative teaching and learning techniques to help students develop their problem-solving techniques while taking the DBMS Laboratory Course. The outcome analysis calculated at the end of the semester Shows that student grades have improved significantly. Also, major changes in calculated and examined attainment of the course outcomes. Many students show observable improvement as a result of the adoption of various creative teaching and learning techniques.

Keywords— Concept Map; DBMS Lab; Online Tools; Project Based Learning; WRITE

JEET Category— Practice.

I. INTRODUCTION

Computers are currently the major technological advancement of the twenty-first century. Therefore, software development and programming are important activities that engage many people across the world [1]. The Relational Database Management System, or RDBMS, is one of the essential course of Information Technology branch, and students nowadays must have both theoretical as well as practical knowledge of it. This subject is crucial for both campus placement and the GATE. A database (DB) is a collection of interrelated data that can be efficiently retrieved, added, and deleted. Data can be organized in many different ways, including tables, schemas, views, reports, etc. [2].

As an example, the college database arranges information on the administration, employees, students, instructors, etc. Using a database, it is simple to retrieve, add, and delete the information [3]. Information Technology curriculums have Database Management System Lab course. In this Core course students must study various basic concepts that relate to Relational database management, SQL, PL/SQL. A database management system is an element of software that makes it easy and quick to store and retrieve data. Set theory, data structures, and an understanding of the fundamentals of computer programming are requirements for this course. The course includes study of SQL (Structured Query Language) i.e., basic operations performed on the database are create, insert, alter, update, modify, delete and PL-SQL. Main contents of the course are Database structure and applications, Relational Model, Integrity Constraints, File Structure and Record Access Mechanism, Query Processing and basics of transaction, Concurrency Control and Crash Recovery.

Every Instructor wishes to implement innovative techniques for teaching. However, there are some situations when it is difficult for a teacher to hold students' interest during an hour-long lesson. Some teachers are combining various instructional techniques in light of this. Project-based learning is an efficient and engaging teaching strategy that aids teachers in developing students' competencies. Due to its effectiveness, participatory nature, and fun nature, project-based learning is one of the best ways to teach Technical and Programming subjects [4][5]. Novak (Novak & Gowin, 1984) introduced the concept map as a visualization tool for displaying the structure of knowledge as a graph. A concept map merely makes use of a collection of information that are related to one another. Students can better organize their thoughts by using the concept map. This concept map may be generated with a tool such as a mind map or C-map. [6]. Concept Map used as a graphical tool for representing ideas/knowledge in the form of a graph. These strategies were useful in encouraging and engaging students to incorporate DBMS concepts for creating simple real-world applications. The quality of teaching DBMS Lab Course has also increased. In order to make education as efficient as possible while minimizing the strain on the student [7]. In this paper, we address the many active learning tools and methodologies that have been used to the teaching of DBMS Course. The result highlights that by implementing these techniques and methods into practice, you can keep students interested in classes, improve their performance, and increase their skill set to meet the needs of the IT industry.

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II. LITERATURE SURVEY

Sunita M Dol (2022), focuses on the implementation of the WRITE instructional strategy to teach a Database Engineering course, with an emphasis on SQL and RDBMS. The paper also aims to improve students' critical thinking and problem-solving abilities. The WRITE instructional strategy (Watch, Read, Implement, Test, Evaluate) is described in detail, explaining each phase's purpose and activities. This strategy seems well-structured and aims to engage students through various learning modalities, such as watching videos, reading handouts, implementing assignments, testing their knowledge, and evaluating their progress. The goal of this study is to help students become improved at problem-solving and critical thinking.

Adem Uzun (2020), This study's objectives were to create a learning environment supported by a problem-based learning approach and to get student opinions on the procedure. In this situation, the problem-based learning approach was used to teach the Database Management Systems course. The case study method, which is one of the qualitative research methodologies, was used for this study. The students were interviewed using a semi-structured interview form to collect the data. Data from the interview were subjected to a descriptive analysis. The results of the data analysis showed that students were generally happy with the problem-based learning strategies.

R. Hima Sagarika (2020), The students' capacity to apply the knowledge they have acquired to actual circumstances in the real world is one of the ongoing challenges in engineering education. The main issue, though, is with understanding how the entire course is organized and how it is used. This study uses the C-Map tool to implement idea maps in a Database Management System (DBMS) course in order to address this. A case study has been done to evaluate the outcomes with conventional teaching versus instruction based on idea maps. Through the use of online tools that are integrated with content and pedagogy, this study promotes successful learning.

Toni Taipalus (2019), Writing incorrect statements while learning a new computer language is a necessary learning experience. However, certain mistakes continue to exist after the query has been written and are never fixed. Expressions, joins, grouping, and ordering are just a few of the principles that make up Structured Query Language (SQL), all of which by their very nature attract various potential problems while constructing queries. Additionally, compared to other faults, some of these are rather simple for a pupil to correct. Results indicate that logical flaws and difficulties are more likely to persist than syntax and semantic faults. The outcomes should allow us to better identify the types of errors that students

encounter, allowing us to, for example, assist teachers in selecting or generating more pertinent data.

Prasanna Kumar MK (2016), The aim of this paper is to demonstrate how project-based learning may help students improve their soft skills, such as teamwork and communication, as well as their technical or professional competencies, such as critical thinking and learning. A case study is developed for students in the Electrical Cluster as a one-month value-added project-based learning course using the Unified Technology Learning Platform (UTLP). Throughout the course, the student's learning outcome is assessed on a regular basis. This paper demonstrates how project-based learning can help produce professionals that are knowledgeable and well-prepared. This paper also offers a project assessment strategy that can be used to provide learning results that are successful.

Akın Efendioğlu (2010), the aim of this study was to explore the effects of two alternative approaches on the academic performance and attitudes of primary school teacher candidates toward computer-based education, and to describe their perspectives on these approaches. There were 36 students in the first experimental group, which used programmed instruction (PI), and the second experimental group, which used meaningful learning (ML). While there was a substantial difference in academic performance across the groups, there was no significant difference in attitude scores between the groups. In both groups, there was no discernible variation in the academic standing of the students according to their gender. Additionally, while there was no discernible variation in the attitudes of students in the PI group between pre- and post-test, a substantial difference was found in the ML group. Students in the PI group generally thought the approach was efficient but tedious. Additionally, the students in the ML group thought favorably of the approach.

III. METHODOLOGY

There are many evidences in literature in which different innovative techniques are worked out and experimented for delivery of Database Management System Lab course. There was a total of 72 Students in Class. DBMS Lab (Database Management System Lab) is a Laboratory course for Third year Students. Author implemented different active teaching learning techniques for successful conduction of this course to improve CO attainment and Result. The Course Outcomes for DBMS Lab are enlisted below:

After successful completion of the course, students will be able to,

1. Sketch E-R diagram for given Case Study/ Problem Statement.
2. Write SQL query for various operations like retrieval, insertion and manipulation of data etc.

3. Apply PL/SQL for implementing Cursor, Procedure/Function and Trigger.
4. Students will be able to design and implement database applications.
5. Implement basic commands of MongoDB with installation.

In OBE, assessment is done through various processes carried out by the institution to identify, analyze and evaluate data towards the achievement of Course Outcomes (COs). Course outcomes (COs) are initially defined for each course based on program outcomes (POs) and other requirements. The COs are evaluated and assessed at the end of each course to determine how effectively they have been attained. Attainments of the COs are measured both directly and indirectly. Direct attainment is determined by evaluating the student's knowledge and skills from their performance in all the relevant assessment methods such as ISE (In Semester Exam), assignments, quiz and ESE (End Semester Exam). These methods provided comprehensive summary of student learning. Through indirect methods like Course Exit surveys, Alumni Feedback, Employee's Feedback and thoughts have been analyzed. CO attainment for the Laboratory is continuously assessed through CAS (Continuous Assessment Sheet), Programming Tests, viva performance and mini project marks. ISE plan for DBMS is shown in Table 1 CAS for DBMSL course is shown in Fig.1.

Table 1 ISE plan for DBMS Lab

Sr. No.	Model of ISE	Weightage	Tentative Schedule
1	CAS	30 M	Throughout the semester.
2	Demonstration & implementation of selected mini project topic	15 M	End of Semester
3	Use of Online Tool for E-R diagram	5M	2 nd Week

The above Table 1 shows ISE (In Semester Exam) plan for course DBMS Lab. ISE component is distributed in three sections i.e., first is CAS (Continuous Assessment Sheet) is for 30 Marks and it is evaluated throughout semester, second is Demonstration & implementation of selected mini project topic is for 15 Marks and it is evaluated at End of Semester and third one is Use of Online Tool for E-R diagram for 5 Marks and it is evaluated in 2nd week of their academic schedule.

Exp. No.	Date	Title of Experiment	Implementation and Execution of Program & Viva as per Rubric	Date of Submission	Signature of Faculty
1		Study of Entity Relationship Model	30 M		
2		Study of database languages: - DDL and DML commands.			
3		Integrity Constraints			
4		Queries based on String, set operations, aggregate functions, Group by, having and between.			
5		Implement the Queries based on all joins.			
6		Implement user administration: create user, give permission, remove permissions.			
7		Implement PL/SQL Stored Procedure and Functions.			
8		Implement PL/SQL Triggers.			
9		Implement Database Connectivity.			
10		Transaction Recovery -Deferred Database Modification			
11		Transaction Recovery -Immediate Database Modification			
12		Case Study on NoSQL database: - MongoDB			
Total					
CAS = Total/12= 30M					
Mini Project Implementation=15M					
Drawing ER Diagram using Online Tool = 5M					
Total ISE of DBMS Lab (50M)					

Fig. 1 CAS for DBMSL course

In the academic year 2020-21 CO attainment for this course is 92.3, 90.10, 92.00, 90.33 and 93.66 for CO1, CO2, CO3, CO4 and CO5 respectively. So, action Plan for improvement of CO attainment:

- Real Examples should be given to create interest in the topic.
- More SQL problems should be given to students for practice.
- Plan active teaching activities for students for Gate and placement related problems to be discussed to involve the students more enthusiastically in the course.
- Brainstorming Activities need to be planned at the end of the practical session so that students are able to map relational databases.
- To increase interest in SQL, PL SQL query execution, some evaluation methods need to be incorporated.

Developing an application for real time problems for better understating of concepts can be achieved with the help of project-based learning.

So, to implementing above action plan we had implemented following innovative active teaching learning techniques:

A. Project Based Learning

Project based learning is a type of cooperative learning method. This technique provides opportunity to students to work in a team. Project-based learning, often known as project learning, is a type of teaching where students learn by working on various

projects [14]. Students who actively participated in the classes and improved their application-level learning through the use of project-based learning. This method encourages students to perform an independent study, work in small groups to resolve problems from real life, and collaborate.

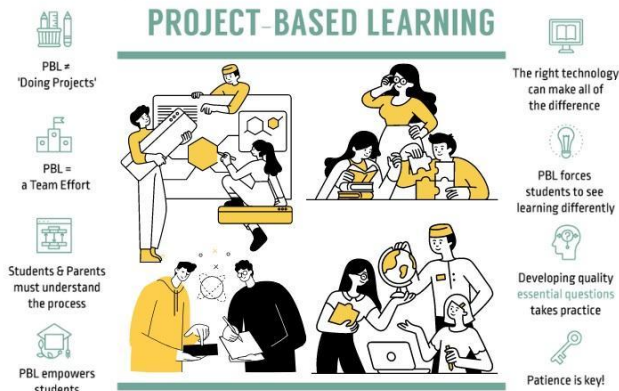


Fig. 2 Project Based Learning [17]

1) Stepwise Procedure of PBL Method:

- Step 1: Prerequisites knowledge should be given.
- Step 2: Creation of a student group of 3-4 students.
- Step 3: Asked them to submit the project title to solve real time problem.
- Step 4: Applying theory into practice.
- Step 5: Presenting solution.
- Step 6: Demo on implementation and Evaluation of project, Project Report submission.

2) Project List:

Total 17 mini project groups done various project using Java and MySQL like Cafe Management System, Smart Traffic Rules Violation Detection System, Library Management System, Criminal's record management system, Fly Buy, Digital steganography, Department application, Student Learning System, Freelancer Management System, Book Shop, Chat Application, Quiz Management System, Ping Pong Game. The below Fig 3 and Fig. 4 shows Mini project group details and demonstration of PBL.

DBMS Lab Mini Project Details 2022-23 (Sem-I)				
Sr.No.	Grp. No.	Name of Student	Team Leader Name	Title of project
1	1	Mailik Mujawar	Swarup Mane	Freelancer Management System
2		Swarup Mane		
3		Pankaj Patil		
4		Shubham Jamadade		
5		Akshata Savadikar		
6	2	Harshal Shirke	Shantanu Bokey	Bank Management System
7		Maihar Padval		
8		Shantanu Bokey		
11	3	Shraddha Dipak	Shraddha Nalawade	Online Exam Platform
12		Gayatri Suhas Patil		
13		Sandhya Shashikant		
14		Pratiksha Narayan		
16	4	Chinmay Pawar	Chinmay Pawar	Criminals record management system
17		Aman shikalgar		
18		Vishwajit mangrule		
19		Aishwarya walvekar		
20	5	Prachi Patil	Aditya Sakhadeo	Fly Buy
26		Aditya Sakhadeo		
27		Omkar Sawant		
28		Pranav Dubal		
29		Omkar Kalukhe		
30		Girish Patil		
		Sumit Pawar		
		Rohit mane		

Fig. 3 Sample mini-Project Details



Fig. 4 Demonstration of mini project (PBL)

3) Rubrics for evaluation:

Course: Database Management System Lab
(ISE II Mini Project)

Each metric listed below carries Max. 10 Marks: 1-Bad, 2-Poor, 3-Average, 4-Good, 5- Excellent (Refer doc for detailed RUBRICS)						Marks of each student					
Sr. No.	Team Work Evaluation (TWE)	Marks	Sr. No.	Individual Work Evaluation (IWE)	Max. Marks: 5	S1	S2	S3	S4	S5	S6
1.	Problem Life Cycle: Identification, Selection, Definition & Analysis		1.	Understanding of Database design and architecture							
2.	Incorporation of RDBMS Concepts in Project		2.	Understanding of Normalization, Relations and Cardinalities							
3.	Innovative & Usefulness		3.	Use of Keys and Entities							
4.	Implementation of Project		4.	Ability to answer questions asked during demonstration							
5.	Use of appropriate Tools / Techniques for project		5.	Reports and queries							
IWE TOTAL (25/5) = (out of 5)											
Total of Each Student's ISE = (TWE Total + IWE of Each Student)											

Fig. 5 Rubrics for evaluation of PBL

The above Fig. 5 Shows rubrics used for evaluation of PBL.

B. WRITE Method

In this Paper, WRITE method [8] activity is used to teach the course Database Management System Lab. WRITE method stands for W- Watch, R- Read, I – Implement, T – Test and E – Evaluate. In the Watch phase student watch the videos uploaded on Moodle by Course in charge. The videos uploaded on Moodle are related with a specific topic as per experiment list. In R-Read phase, students read the guidelines given in the lab manual related to the experiments to be completed. In I – Implement phase, the students implement the experiments while in T-Test phase, course in charge conducted the test on given experiment. Finally, the instructor of the E-Evaluate phase evaluates the test on a particular experiment carried out in the lab sessions. This approach aims to improve students' capacity for reasoning, critical thinking, and problem-solving.

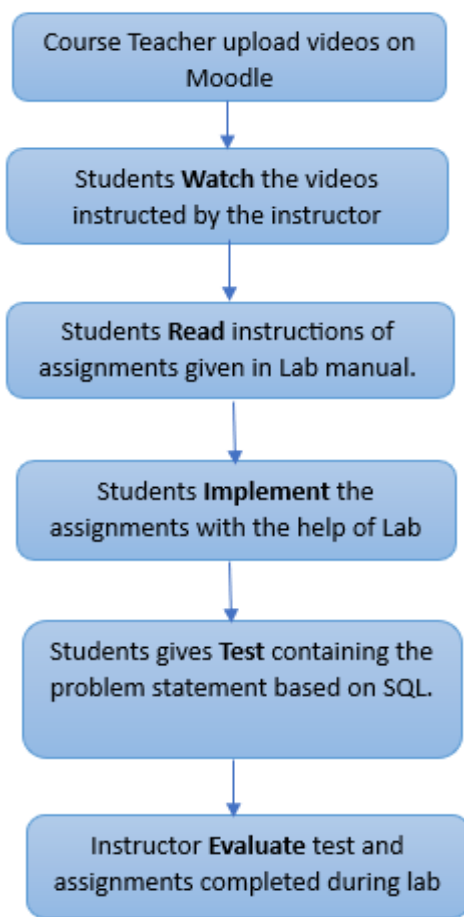


Fig. 6 Flow of WRITE Method

As per Fig. 6 implementation of the WRITE activity was started by Uploading Videos on Moodle for specific concepts and concluded with Evaluation of Test and assignments.

1) Stepwise Procedure of WRITE Method:

Step 1: Students Watch the videos instructed by the instructor

Step 2: Students Read instructions of assignments given in a Lab manual.

Step 3: Students Implement the assignments with the help of a Lab manual.

Step 4: Students give a Test containing the problem statement based on SQL.

Step 5: Instructor Evaluate test and assignments completed during lab sessions.

2) Rubrics for evaluation:

The rubrics used for evaluation of WRITE Method are given in Fig. 7. Each time, the instructor noticed an improvement in the activity's smoothness, students' enthusiasm, and their involvement in classroom.

Rubric used for assignment and test evaluation (WRITE)

Sr. No.		Correct	Partially correct	Incorrect
1	Selection of relation/s for given problem statement			
2	DDL Commands			
3	DML Commands			
4	Integrity constraints			
5	Output of Query			

Fig. 7 Rubrics for Evaluation

C. Use of Online Tools

An E-R Diagram is an essential part of Understanding Fundamentals of Relational DBMS. Students need to understand Entity, attributes, Relationship between entities, mapping cardinality, so in this paper the author involved use of online tools mechanism for drawing E-R diagrams. Author evaluated this technique as a part of the ISE component for 5M. With the help of this, students clearly understand entities and their relationships, and they can easily draw E-R diagrams for any application. Here fig. 8 shows that students have used Draw.io, SmartDraw like tools for drawing E-R diagrams. With the help of this technique students' interest in DBMS Course has increased.

1) Stepwise Procedure of Use of Online Tool:

Step 1: Students need to select a problem statement.

Step 2: Draw schema diagram of selected problem using online E-R diagram drawing tool

Step 3: Students need to submit an E-R diagram on Moodle.

D. Concept Map

A concept map is a form of graphic organizer that helps easy learning of novel concepts and their relationship with other concepts through visual representations. These ideas are shown as boxes or circles with a connecting line showing how they relate to one another. Linking words that are printed on the lines help to clarify the relationships. Concept Maps Helps Students to Brainstorm and Generate ideas, organize and focusing information, linking existing knowledge with new ideas, concept understanding and clearly representation of knowledge.

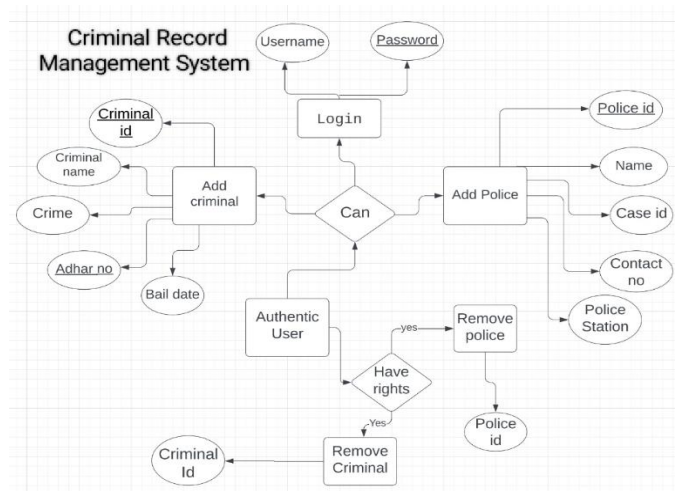


Fig. 8 Sample E-R diagram using Draw.io tool

- How to teach concept maps?
- Start with focus Question
- Recording Concepts
- Finding Connections
- Review and complete Map
- Practice the strategy

Concept Map techniques can be used in Classroom for different purposes like to introduce new topics and to assess prior knowledge, as a learning strategy, as a classroom activity, to evaluate for learning. Fig. 10 shows sample representation of concept map in E-R diagram.



Fig. 9 Concept Map technique

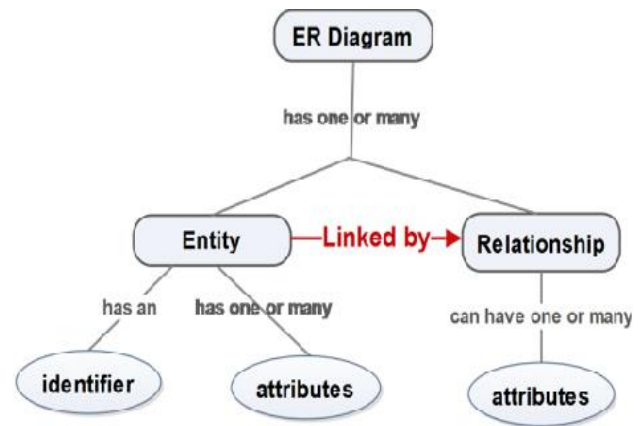


Fig. 10 Sample representation of Concept map in E-R Diagram

IV. RESULT AND DISCUSSION

As all above mention active teaching learning methods planned here is not only for innovative teaching learning but also for effective assessment. The result of direct evaluation is represented in the form of CO attainment graph in figure 13. Using both direct and indirect methods the effectiveness of the abovementioned active learning techniques has been evaluated. Rubrics were used for every activity differently in the direct evaluation method. The evaluation marks have been combined together and mapped with course outcomes. We have taken a Course exit survey through google form shared with students for indirect evaluation of the effectiveness of implementation of PBL, WRITE method and use of Online tool for drawing E-R diagram shown in Fig. 11.

Q. No.	Questions	Strongly Agree	Agree	Good	Poor	Disagree
1	Are you able to: Draw Schema Diagram on given problem statement.					
2	Are you able to: Write SQL query for various operations like retrieval, insertion and manipulation of data etc.					
3	Are you able to: Implement PL/SQL cursor, procedure/function and trigger.					
4	Are you able to: describe basic concepts of MongoDB.					
5	How well is the course plan and assessment plan of the course designed?					
6	I feel WRITE method and use of online tools activities helped me for better understanding of Practical concepts.					
7	I feel that through PBL, Concept map can solve any real-world problem through Theoretical concept taught in class.					
8	Did you enjoy attending the course?					

Fig. 11 Rubrics for Indirect Attainment

The result analysis of this course is represented in the form of graph in Fig.12 and Table 2 represent the grades of students.

For analysis of the result of implemented activities, we have compared the results of the DBMS Lab course taught in AY 2021-22 and AY 2022-23.

From the analysis Table 2 of the result, it shows that there are large numbers of students are shifted from lower to higher grades in AY 2022-23 as compared to AY 2021-22.

Table 2 Result analysis

Grades / Year	AA	AB	BB	BC	CC	CD	DD	Fail
2021-22	5	12	25	20	4	0	0	6
2022-23	12	25	28	7	0	0	0	2

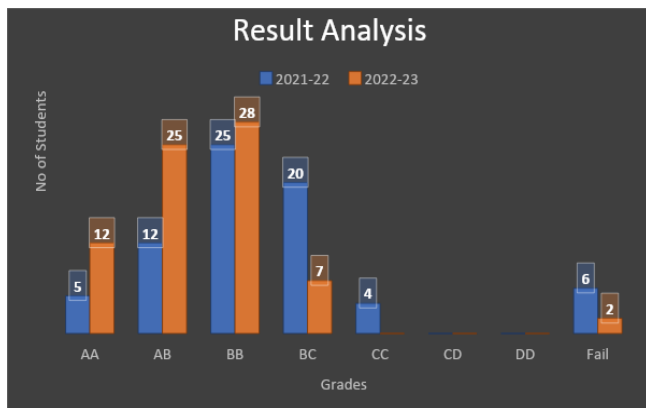


Fig. 12 Result analysis graph

The result of direct and indirect evaluations are represented in the form of CO attainment graph in Fig.13 and Table 3 shows the numerical values of CO attainment.

Table 3 CO- attainment

CO	CO Statement	Overall Percentage Attainment 2020-21	Overall Percentage Attainment 2021-22
CO1	Sketch E-R diagram for given Case Study/ Problem Statement.	92.3	95.5
CO2	Write SQL query for various operations like retrieval, insertion and manipulation of data etc.	90.10	96.3
CO3	Apply PL/SQL for implementing Cursor, Procedure / Function and Trigger.	92.00	94.05

CO4	Students will be able to design and implement database applications.	90.33	97.4
CO5	Implement basic commands of MongoDB with installation.	93.63	93.75

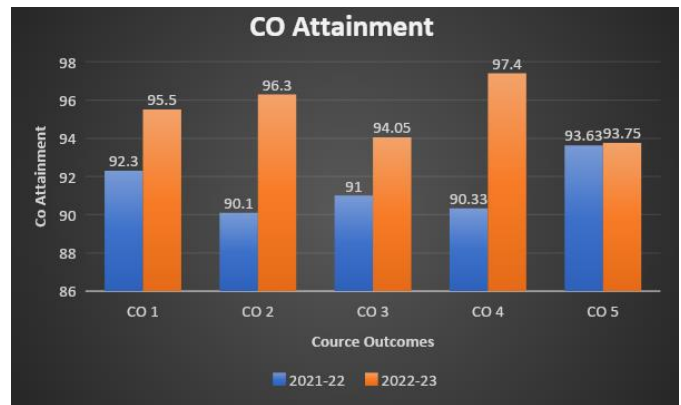


Fig. 13 CO-Attainment Graph

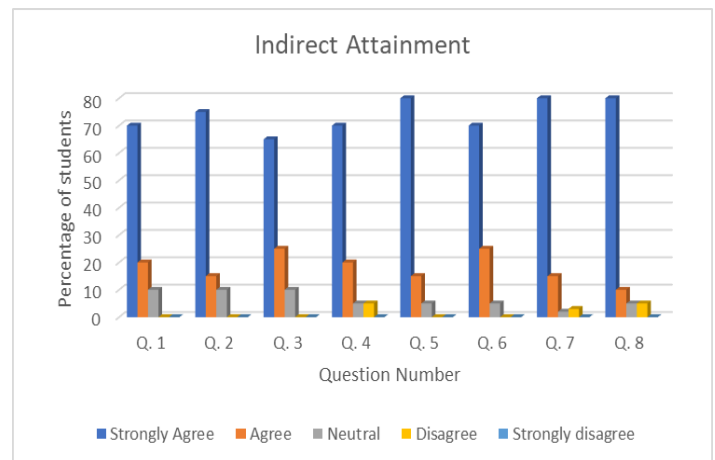


Fig. 14 Indirect attainment graph

Following are the outcomes of the active learning techniques used in DBMSL through feedback,

1. Students strongly agree that they can able to draw schema diagram on any given problem statement.
2. Students can create relation database for any applications using DBMS concepts.
3. With the help of WRITE method students can efficiently implement SQL, PLSQL queries.
4. With the help of Project based learning and Concept Map activities, teamwork, thinking ability and students' confidence enhanced.
5. Students strongly agree that they can solve any real-world problem through theoretical concepts taught in class.

Form the CO attainment and Result analysis it is observed, significant growth in overall performance of students as compared to traditional teaching-learning process.

V. CONCLUSION

According to our survey, students were more interested in applying the theory, principles, and practices of software engineering, programming concepts and relational database management concepts to real-world software development projects using the PBL methodology. Students claimed that through working on project, they learned about different DBMS concepts, database architecture and Java programming, and how these concepts may be used at the application level. Concept maps aid learners in self-discovery and structural knowledge of concepts, enabling them to solve complex real-world problems through improved conceptual knowledge for various applications. To increase interest in DBMS course instructor involves use of online tools for drawing ER Diagram. WRITE, Concept map and use of online tools methods useful for deep understanding of various aspects of DBMS Lab course. With the help of these activities, conduction of continuous assessment for DBMS Lab course have been easier. The result of the implementation shows the students' performance has improved with the help of different active teaching learning methodologies used. The number of students progressing from lower to higher grades has increased, as has the CO achievement.

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