REVIEW PAPER ON:"CO-PO MAPPING AND ATTAINMENT FOR COURSES OF UNIVERSITY AFFILIATED ENGINEERING PROGRAMS."

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ABSTRACT

Outcome-Based Education (OBE) focuses on ensuring students achieve specific program outcomes (POs) by graduation. These outcomes are aligned with the National Board of Accreditation (NBA) standards, aiming to equip students with globally recognized skills. The curriculum is designed to map course outcomes (COs) to POs through various teaching-learning methods. Traditionally assessed using Excel, the process of calculating CO-PO attainment has been automated, streamlining the evaluation of student performance and the achievement of program goals. The system also generates reports to confirm whether the desired outcomes have been met

Keywords – Outcome-Based Education (OBE), Program Outcomes (POs), Course Outcomes (COs), National Board of Accreditation (NBA), Curriculum Design, Teaching-Learning Methods, CO-PO Mapping, Attainment Calculations, Student Performance Assessment

1. INTRODUCTION

Outcome-Based Education (OBE) is an educational approach that prioritizes what students are expected to achieve by graduation, focusing on outcomes rather than content. In OBE, Program Outcomes (POs) define the skills, knowledge, and abilities students should possess upon completing their program. These POs align with standards from bodies like India's National Board of Accreditation (NBA), emphasizing competencies such as problem-solving, ethical decision-making, and communication.

Course Outcomes (COs) are mapped to POs, ensuring each course contributes to overarching program goals. Assessing CO-PO attainment traditionally relied on manual calculations, which are time-consuming and prone to error. However, automation offers a solution by streamlining the calculation of CO-PO attainment, improving accuracy and efficiency, and providing real-time insights into student progress. Automated systems generate detailed reports on student and cohort performance, guiding curriculum improvement and resource allocation.

Such automation supports NBA accreditation by simplifying quality tracking and reporting, essential for continuous improvement. This shift aligns with broader educational trends toward data-driven decision-making, enhancing student outcomes and curriculum effectiveness. By automating CO-PO calculations, institutions can efficiently monitor learning outcomes, contributing to quality education and student success in a competitive landscape.

Problem Definition

- Inaccuracy: Manual calculations increase the risk of errors, compromising the integrity of student performance assessment.

- Time-Consumption: The process is labor-intensive, resulting in delays in evaluating student progress and program effectiveness.

- Lack of Real-Time Insights: Delayed reporting makes it difficult for educators to promptly adjust teaching strategies and improve learning outcomes.

- Difficulty in Scaling: As student enrollment increases or curriculum changes, the manual system struggles to efficiently handle larger datasets.

Objectives

- To effectively map course outcomes (COs) to program outcomes (POs) across all courses in the program. This involves ensuring that each course's specific outcomes are clearly aligned with the broader program outcomes for comprehensive educational alignment.

- To develop a system that automates the calculation of CO-PO attainment, reducing manual effort and increasing accuracy. The goal is to create an automated system that streamlines the process of calculating how well course outcomes meet program outcomes, minimizing human error and effort.

- To assess student performance through both direct (e.g., exams, assignments) and indirect (e.g., surveys) methods to determine the level of CO and PO attainment. This involves evaluating student performance using a mix of direct assessments like exams and assignments, as well as indirect methods such as surveys to gauge the attainment of course and program outcomes.

- Demonstrating analytical thinking. Demonstrating analytical and critical thinking abilities for database decision thinking.

2. LITERATURE SURVEY

[1.] Paper Name: Implementing an Application for Attainment Calculation of Program Outcomes and Course Outcomes for Courses of University-Affiliated Engineering Programs

Author(s): Hasib Masud Shaikh, Arun Kumar

Publication: International Journal of Engineering and Advanced Technology (IJEAT)

Explanation: This paper discusses the automation of manual processes used in Outcome-Based Education (OBE) for calculating the attainment of Course Outcomes (COs) and Program Outcomes (POs). In OBE, program outcomes are crucial in defining the knowledge and skills that students should acquire by graduation. These outcomes are aligned with standards from the National Board of Accreditation (NBA), ensuring students are equipped with globally competitive skills.

Traditionally, CO-PO attainment has been calculated using MS Excel based on students' performance in assignments, tests, projects, and course exit surveys. The system proposed in the paper automates this process by collecting both direct (marks, experiments, etc.) and indirect assessment data (surveys) and calculating whether the program outcomes have been achieved. Additionally, it generates summary sheets showing the attainment of COs and POs for evaluation purposes. [1]

[2.] Paper Name Method for estimation of Attainment of Program outcome through Course outcome for Outcome based Education

Author(s): Shivakumar Ramchandra1, Samita Maitra1* and K MallikarjunaBabu

Publication: IEEE International Conference on MOOC, Innovation and Technology in Education (MITE)

Explanation: This paper explores the concept of Outcome-Based Education (OBE) and its role in preparing engineering graduates for global competitiveness. OBE ensures that students achieve the 12 program outcomes defined by the National Board of Accreditation (NBA) in India. These program outcomes aim to provide graduates with both a sound knowledge base and global mobility and acceptance.

The curriculum is designed to train students in these outcomes through classroom teaching, lab experiments, seminars, and projects. Each course has specific Course Outcomes (COs) that are mapped to the Program Outcomes (POs). Student performance is assessed through detailed question paper articulation, where each question is mapped to the COs and their corresponding POs. The results are analyzed using MS Excel, enabling educators to measure the attainment of both COs and POs for each batch of students. [2]

[3.] Paper Name: Assessment of Program Outcomes in Outcome Based Education through Students' Co-Curricular Activities

Author(s): Suji Prasad S J , Thangatamilan M, Sureshkumar R, Revathi P

Publication:Journal of Engineering Education Transformations ,

Explanation: This paper examines the role of co-curricular activities in assessing program outcomes within the Outcome-Based Education (OBE) framework, which has gained prominence in the Indian higher education system. The National Board of Accreditation (NBA) and the National Assessment and Accreditation Council (NAAC) emphasize the importance of evaluating program outcomes.

The proposed method highlights the use of rubrics-based measurement for assessing program outcomes (PO1-PO12) and Program Specific Outcomes (PSO1 & PSO2) through students' co-curricular activities, including paper and project presentations and internships/industrial projects. By integrating these activities into the assessment process, the paper aims to enhance the evaluation of program outcomes and contribute to the advancement of higher education in India. [3]

[4.] Paper Name: Outcome-based assessment in India: A method for quantifying course outcome attainment

Author(s): Selva Mary G.1, Mrudul Arkadi2, Sangeetha K.3, Shubhangi Suryawanshi4, John Blesswin A.1,

Publication: Journal of Autonomous Intelligence

Explanation: This paper focuses on the quantification of Course Outcomes (COs) in the context of Outcome-Based Education (OBE) as mandated by the National Board of Accreditation (NBA) in India. The NBA, established by the All India Council of Technical Education (AICTE), emphasizes OBE to ensure the quality and effectiveness of engineering programs.

OBE aims to achieve significant outcomes, expand success opportunities, and set high expectations. Each course within this framework is defined by specific course outcomes, which need to be assessed and evaluated at the end of the course to determine whether the expected outcomes have been achieved. This assessment is crucial for verifying the efficiency of the teaching and learning process.

The paper describes a method to quantify CO attainment and measure it against target levels. It outlines assessment methods and tools for collecting and preparing data to evaluate CO attainment. This method is applicable to all engineering programs seeking NBA accreditation and supports continuous improvement and quality assurance in education. [4]

[5.] Paper Name: Effectiveness of Outcome Based Education (OBE) toward Empowering the Students Performance in an Engineering Course

Author(s): Devasis Pradhan

Publication: Journal of Advances in Education and Philosophy

Explanation: This paper explores the contemporary trend of Outcome-Based Education (OBE), which aims to enhance students' professional careers by fostering informed and creative development. OBE emphasizes the need for effective assessment methods to evaluate graduate attributes and improve the teaching-learning process.

The paper begins by tracing the origins of OBE and introducing its core principles. It discusses the concept of outcomes and how it necessitates a shift in evaluation and assessment practices. The focus is on bridging the gap between teaching methods and outcome-based learning approaches.

The paper further examines the practical implications of implementing the OBE framework, particularly in engineering education. It discusses assessment and evaluation strategies for student performance and aligns these practices with the four key principles of OBE. [5]

Methodology

1. **Project Planning and Requirements Gathering**
   o **Define Project Scope**: Establish the objectives and deliverables of the project, including automating CO-PO attainment calculations and generating reports.
   o **Gather Requirements**: Document the requirements for CO-PO mapping, data collection, attainment calculations, and reporting. Identify any specific features or functionalities needed.

2. **System Design and Architecture**
   o **CO-PO Mapping Framework**: A framework for mapping Course Outcomes (COs) to Program Outcomes (POs). This framework should include the structure of the CO-PO matrix and the criteria for alignment.
   o **Architect System**: Design the architecture of the automated system, including data input methods, calculation algorithms, and reporting functionalities. Choose appropriate technologies and tools for system development (e.g., databases, programming languages, reporting tools).

3. **Development and Implementation**
   o **Develop Data Input Interface**: Create user-friendly interfaces for entering performance data, including assessment scores and student feedback.
   o **Implement Calculation Algorithms**: Develop and integrate algorithms for calculating CO-PO attainment levels based on the input data. Ensure that the algorithms are accurate and align with the predefined criteria.
   o **Build Reporting Module**: Implement a reporting module to generate detailed reports on CO-PO attainment. Include features for customizing reports, visualizing data, and exporting results.

4. **Testing and Validation**
   o **Unit Testing**: Conduct unit tests for individual components of the system to ensure that each part functions correctly.
   o **Integration Testing**: Test the integrated system to ensure that all components work together seamlessly and that data flows correctly between modules.
   o **User Acceptance Testing (UAT)**: Engage with stakeholders to test the system in a real-world scenario. Collect feedback on usability, functionality, and performance.

o **Validation**: Verify that the system meets all requirements and accurately calculates CO-PO attainment. Ensure compliance with accreditation standards.

5. **Deployment and Training**

o **Deploy System**: Roll out the automated system to the intended users. Ensure a smooth transition by following a deployment plan that includes data migration and system setup.

o **Train Users**: Provide training sessions and documentation for users to familiarize them with the system. Offer support for any questions or issues that arise during initial use.

6. **Monitoring and Maintenance**

o **Monitor System**: Continuously monitor the system to ensure it operates efficiently and effectively.

o **Perform Regular Maintenance**: Update the system as needed to fix bugs, improve performance, and incorporate user feedback. Ensure that the system remains aligned with evolving accreditation standards and institutional needs.

7. **Continuous Improvement**

o **Collect Feedback**: Gather feedback from users on system performance and effectiveness. Identify areas for improvement based on this feedback.

o **Update System**: Implement enhancements and updates to address identified issues and improve system functionality. Regularly review and update CO-PO mapping and calculation criteria as needed.
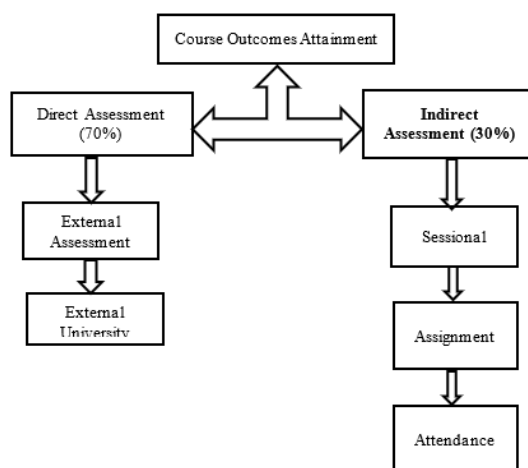
Data flow Diagram

Fig.1 Data flow Diagram

Advantages & Disadvantages

Advantages

1. **Efficiency and Time Savings:**

o **Automated Calculations:** Reduces the time required for calculating CO-PO attainment compared to manual methods like Excel.

o **Streamlined Reporting:** Automatically generates reports, which speeds up the process of evaluating program outcomes and preparing accreditation documents.

2. **Accuracy:**

o **Reduced Human Error:** Minimizes errors that can occur with manual calculations.

o **Consistent Results:** Provides consistent and reliable data for evaluating student performance and program effectiveness.

3. **Enhanced Data Management:**

o **Centralized Data:** Offers a centralized system for managing and analyzing data related to COs and POs.

o **Comprehensive Tracking:** Facilitates better tracking of student performance over time and across different cohorts.

4. **Improved Transparency:**

o **Clear Metrics:** Provides clear metrics and visualizations for user to assess the achievement of program outcomes.

o **Accreditation Readiness:** Ensures that data is readily available for accreditation reviews and audits.

5. Customization and Flexibility:

o **Adaptable Systems:** Allows for customization to fit specific institutional needs and changes in curriculum or accreditation requirements.

o **Scalability:** Can be scaled to accommodate changes in the number of courses, outcomes, or program requirements.

Disadvantages

1. Technical Challenges:

o **System Integration:** May face challenges in integrating with existing institutional systems or databases.

o **Technical Issues:** Potential for technical glitches or system failures that could impact data accuracy or availability.

2. Dependence on Technology:

o **System Reliance:** Heavy reliance on technology could be problematic in the event of system outages or malfunctions.

o **Data Security:** Requires robust security measures to protect sensitive student and program data from breaches or unauthorized access.

3. Complexity and Learning Curve:

o **User Complexity:** The system may be complex, requiring significant time for users to become proficient.

o **Resistance to Change:** Faculty or staff accustomed to traditional methods may resist transitioning to a new system.

4. Ongoing Maintenance:

o **Regular Updates:** Requires ongoing maintenance and updates to ensure compatibility with new versions of software or changes in accreditation standards.

3. CONCLUSION

In summary, automating CO-PO mapping and attainment calculations is a feasible and valuable project for engineering programs. This system would streamline the process, reduce errors, and provide real-time insights, aligning with NBA standards and enhancing the accuracy and efficiency of student performance evaluation. Implementing this project would support continuous improvement, facilitate accreditation compliance, and strengthen data-driven decision-making in educational institutions.

4. REFERENCES

[1] Hasib Masud Shaikh, Arun Kumar "Implementing an Application for Attainment Calculation of Program Outcomes and Course Outcomes for Courses of University-Affiliated Engineering Programs" International Journal of Engineering and Advanced Technology (IJEAT)

[2] Shivakumar Ramchandra1, Samita Maitra1* and K MallikarjunaBabu "Method for estimation of Attainment of Program outcome through Course outcome for Outcome based Education" IEEE International Conference on MOOC, Innovation and Technology in Education (MITE)

[3] Suji Prasad S J , Thangatamilan M, Sureshkumar R, Revathi P "Assessment of Program Outcomes in Outcome Based Education through Students' Co-Curricular Activities" Journal of Engineering Education Transformations .

[4] Selva Mary G.1, Mrudul Arkadi2, Sangeetha K.3, Shubhangi Suryawanshi4, John Blesswin A.1, "Outcome-based assessment in India: A method for quantifying course outcome attainment " Journal of Autonomous Intelligence.

[5] Devasis Pradhan "Effectiveness of Outcome Based Education (OBE) toward Empowering the Students Performance in an Engineering Course" Journal of Advances in Education and Philosophy.

[6] yelade, O. J, Oladipupo, O.O, Obagbuwa, I. C, "Application of k-Means Clustering algorithm for prediction of Students' Academic Performance," (IJCSIS) International Journal of Computer Science and Information Security, Vol. 7, No.1, 2010.

[7] Mousami Vanjale, Member, IEEE, Sachin Shelar, Member, IEEE, Dr. P. B. Mane, "Assessment of Course Outcomes (COs) in University Affiliated Engineering Programs," IEEE, 2015.

[8] Jan Skalka, Martin Drilik, Juraj Obunya, "Automated Assessment in Learning and Teaching Programming Languages using Virtual Learning Environment," IEEE Global Engineering Education Conference (EDUCON), 2019.

[9] Akash Rajak, Ajay Kumar Shrivastava, Divya Prakash Shrivastava, "Automating Outcome Based Education for the Attainment of Course and Program Outcomes," IEEE, 2018.