

# Case Study: Effect of CO-PO Mapping and Attainment on Third-Year B Pharm Students

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## ABSTRACT

**Aim/Background:** This paper discusses a case study using CO-PO mapping and accomplishment for Tier II institutes' third-year B.Pharm students. It is required to be outcome-based education in accordance with the National Board of Accreditation's June 2015 scheme. There are observable disparities in students' employability when it comes to the acquisition of professional expertise and abilities and the growth of an attitude of professionalism. Tier II students have a significant chance to close the placement and higher education gap by following the guidelines outlined in NBA Manual Criteria 3 on CO-PO mapping and accomplishment. **Materials and Methods:** In the current paper, with help of third year B Pharm students we tried to established rubrics assessment and use of algorithm suggest a systematic approach to continual enhancement strategy that teachers and students in the pharmacy stream can readily apply. **Results:** On mapping each CO with each PO and using different techniques to bridge the gaps significantly improves performance of student as the orientation is changed. **Conclusion:** Applicability of OBE in curriculum is welcoming by students and will give desired outcomes if implemented properly.

**Keywords:** CO-PO attainment, CO-PO mapping, Employability, Learning Objective, Learning Outcome, Outcome Based Accreditation, Program Outcomes.

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## INTRODUCTION

Based on Outcome Based Accreditation (OBA) June 2015 format of Tier-II of NBA, has proposed for implementation of revolution in Pharmacy education to catalyze amendment of outcome-based processes to enable the students to achieve their dreams and PEO's set by institutions.<sup>1</sup> All the Tier II institutions have an opinion that they are constrained with curriculum set by university or council. However, university and PCI curriculum is minimum prescribed and additional efforts by faculty are always a welcome step. Due to time and intake quality constraint of students, faculty members face dilemma in adaption of additional systems and their effectiveness. NBA recommends usage of graduate attributes as a very effective solution to attain in form of "Program Outcomes".<sup>2,3</sup> This is required to be gradually build right from admission till graduation as quality requires consistent effort. Many of companies during campus placement tests or for higher studies when students appear for GPAT exam "Basic Concepts" of students related to all the 4 Year courses.

So professional attribute development for any student starts from first year itself. It's very important that student just securing passing marks do not become passive towards studies and overall development efforts taken by institution. And faculty role and students interest get properly mapped.<sup>4</sup>

As the number of institutions is increasing along with autonomy colleges in India, it is not wise to expect these Program outcomes to be attained by students on their own, without active involvement of faculty. Though CO-PO attainment and along with mapping, is expected from faculty for overall development of Students in all aspects, covered by Program Outcomes (POs).<sup>5,6</sup>

Therefore, faculty has great responsibility towards development of students. Hence in normal perception, faculty should be bestowed with authority to cover the gap between what is taught and what is expected in field. Therefore, there is a need of getting this curriculum gaps and employability aspects filled through CO-PO mapping ensuring active faculty involvement in overall development of student.<sup>7</sup> With the OBE systems of NBA, all faculties are now getting great opportunity to address this aspect through CO-PO Mapping and Attainment as they can themselves plan and fill the gaps of prescribed curriculum with active or passive participation of stakeholders.<sup>8,9</sup>

This CO-PO mapping process starts with LO designing as per syllabus content and Mapping of CO with LO and the CO with PO.



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This tool is intended to support in developing and implementing learning outcomes when you create and teach courses.<sup>10</sup> It contains pertinent terminology as well as information on the features and advantages of learning outcomes. Those who are constructing a course from scratch, redesigning an existing course, or instructing a course that was created by someone else will find the resource beneficial, as shown in Figures 1 and 2.<sup>11-13</sup> Examples of learning objectives and learning outcomes with activity created by tutor shown in Table 1.

Improvement/action plan to be taken to improve the attainment level of subject<sup>14</sup> is elaborated in Figure 3 where Assessment Plan, curriculum and Academic Processes explained with stepwise procedures.

While tutor start preparing the course booklet for selected subject, he/she start the work from CO formulation, selection of assignments for attainment of CO and critical parameter like Gap Analysis and accordingly planning for academic yearly activities, that will help the teacher for completion of course smoothly; all these methods explain in systematic manner in Figure 4.<sup>14</sup>

## MATERIALS AND METHODS

In this study a sample size of 65 students from third Year B Pharm of Dr D Y Patil College of Pharmacy, were selected. The students were subjected to various formative and summative assessments like lab work, assignment in form of quiz, games etc, and Sessional exam for the subject of Industrial Pharmacy-I. These were further evaluated using rubrics assessment and algorithm, number of students benefitted were identified considering > 70%marks as level 3, >60%marks as level 2 and more than 50% marks as level 1. In addition, along with sessional marks during the process of assignment submission students were evaluated based on willingness to submit assignment, completion of assignment as per expectation, referred more than 2 sources for

completion and their involvement, or just completed for sake of compulsion.

## RESULTS

### CO-PO mapping and assessment

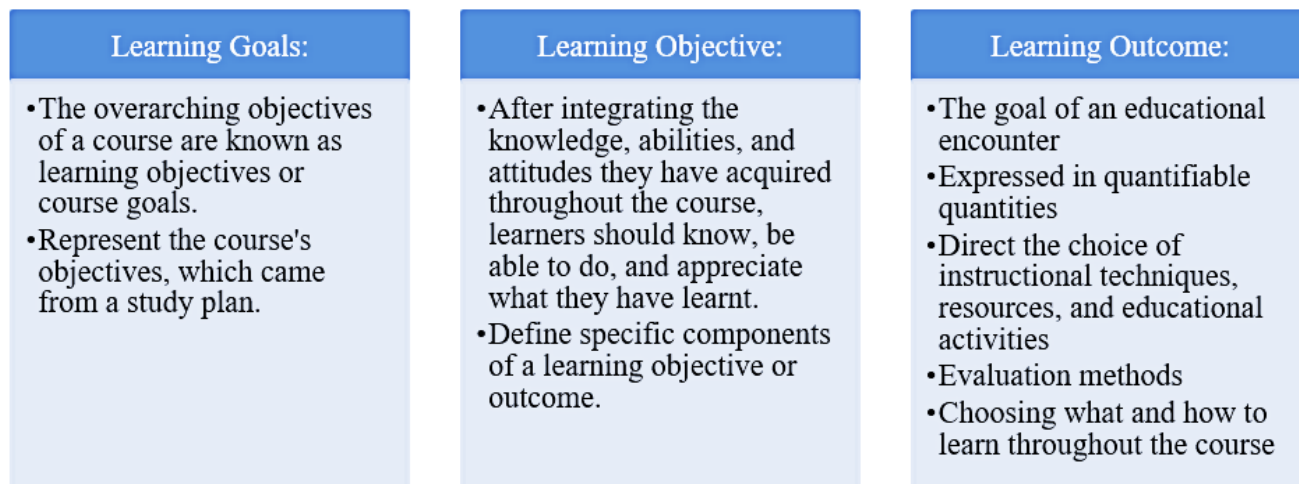
All test, lab, assignment, course exit and exam data, as well as Blooms level, are imported from a faculty topic course file and included in the course and program outcome (CO-PO) evaluation.<sup>15,16</sup>

From the Table 2 it can be concluded more than 60% students' performance is showing improvement and desire to outshine which is encouraging. Only 50% students show willingness to submit assignment and as per expectation while nearly 20% student submitted the assignment for sake of just submission. Which also indicates there is need for motivation to the students to study make the subject more interesting. Figure 5 shows significant improvement in performance of student as the orientation is changed. PO4, PO9 and PO10 are strongly mapped while others are Moderately mapped based on matrix and attainment of PO from CO.

## DISCUSSION

### Important points in consideration for CO-PO Mapping and Attainment are listed below

A subset of POs can be addressed by each CO. Example Course: Industrial Pharmacy Third Year B.Pharm unit 1 Preformulation CO1-Discuss various concepts of preformulation and perform experiments showing influence of various additives on dosage form design and stability; evaluation parameters well explained in Table 3. This type of addressing each PO with each CO can be done for all the subjects, more appropriately to those who have practical's associated with them and those theory subjects where practical's are not there over their this mapping can give brief overview of curriculum gaps and accordingly can plan to fill it.



**Figure 1:** Concept of learning goals, objectives and outcomes.

**Table 1: Examples of learning objectives and learning outcomes with activity created by tutor.**

Sl. No.	Activity details	Learning objective	Learning outcome	Conclusion
1	An onboarding class/ Orientation session for newly admitted students.	Will understand policies laid by institutes/ universities regarding academic regulations.	By taking the appropriate measures, students can practise and reflect on scenarios when institute/university policies are applicable.	Understanding, competence and intellectual skills are the focus of learning outcomes.
2	Seminar/poster presentation.	Will develop Presentation and organization skills.	Will be able to demonstrate proficiency in defining and clarifying the subjects being discussed, finding pertinent material and organising their oral work.	Will show a thorough comprehension of the material as well as proficiency in voice projection, modulation and timing. With or without notes, they will be able to speak persuasively and utilise visual, aural and audio-visual aids to enhance their presentation.
3	Virtual reality hands on training session for instruments.	Session will demonstrate the steps by steps process for handling an instruments as per SOP.	Learners can correctly operate the instrument as per described SOP and explain applications parameters.	The learning objective relates to motor abilities. In addition to solving problems when they arise, learners can use instruments to physically exhibit the results of their learning.
4	Group Discussion.	Share knowledge and ideas	In addition to being able to speak and write clearly and loudly, students will also be able to answer to a variety of questions, participate in group discussions to reach consensus, demonstrate intellectual leadership and manage their time well.	The learning objectives cover critical thinking, questioning, time management, appropriate voice modulation and involvement.
5	Quizzes	This helps the students do critical thinking and get into a habit of innovative learning.	Help to build confidence and encourage students to take an active role in their learning.	Quiz is a tool for assessing student development and identifying areas where additional support may be needed.
6	Games	Using the special qualities of games, game-based learning uses the elements of play to effectively teach and guide students towards learning objectives.	Enhance students' capacity for creativity, critical analysis and problem-solving.	It encourages a learning atmosphere that is focused on the needs of the students, wherein their well-being and soft competencies are developed in a lively, joyful and playful manner.
7	Field visit	To strengthen experiential and contextual learning.	They serve as a link between theoretical understanding and practical application. Field visits enhance learning by offering students concrete experiences that are memorable, pertinent and captivating.	Field excursions foster a sense of wonder and curiosity as well as critical thinking and observational skills.

8	Working Model making.	To improve tangible nature in order to develop understanding via their tactile senses by focussing on their hands when producing objects; to support the practice of learning by doing.	It fosters students' scientific content knowledge while developing their understanding of the nature of science.	Give students an engaging, activity-based learning experience to help them build critical thinking abilities.
9	Group activities like Problem based learning, Think pair share or peer learning, collaborative learning, Role play, case study, etc.,	Gives students chances for self-reflection that they may lack when working alone, as well as more practical experience with the processes of teamwork and collaboration.	Take on more difficult issues than they could handle alone. Assign duties and positions to others. Exchange different points of view. Combine your expertise and abilities. Be accountable to each other and to one other. Get social support and motivation to take chances. Create fresh strategies for settling disputes. Create a common identity among the group members. Look for successful peers to model yourself after. Grow their own voice and viewpoints in comparison to their peers.	It enables them to cooperate with one other so they can share knowledge and work together to solve issues. Additionally, it helps pupils develop their communication skills and exposes them to various viewpoints.

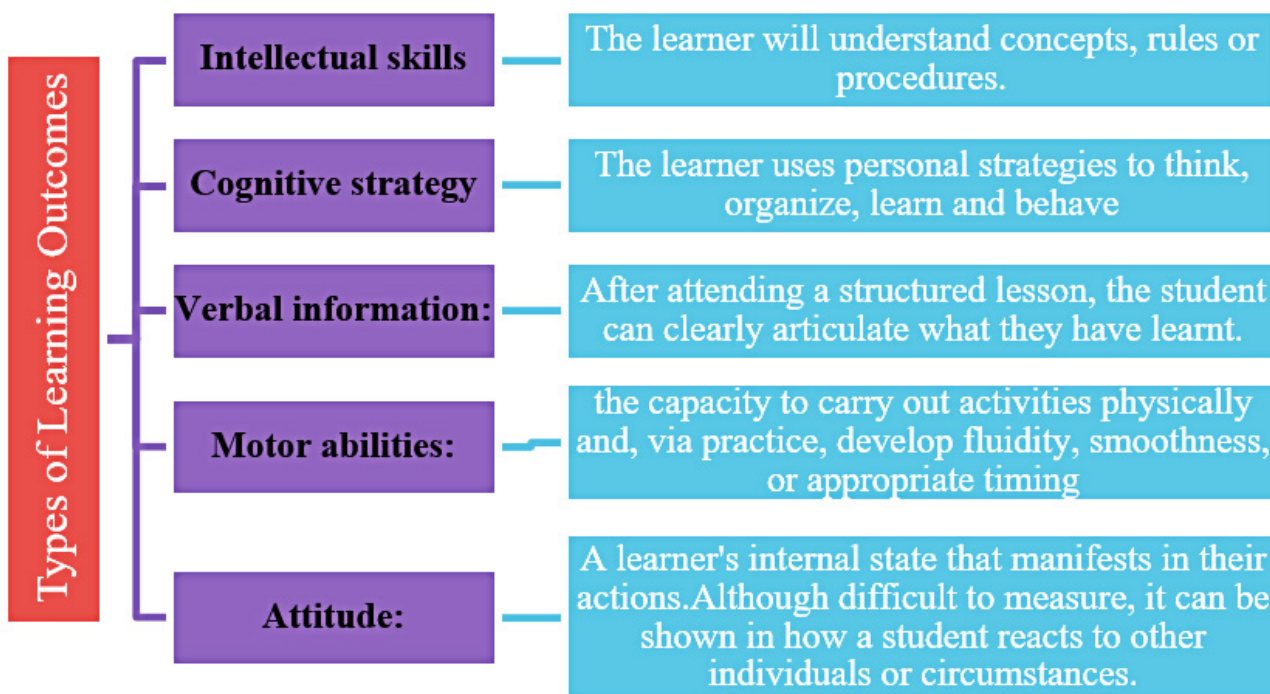


Figure 2: Types of learning outcomes.<sup>12,13</sup>

**Table 2: CO -PO attainment matrix based on marks obtained in sessional exam and assignment marks.<sup>18</sup>**

Rubrics	Does not meet expectations Level 1	Meets Expectations Level 2	Exceeds Expectations Level 3
Number of Students			
CO1-PO	0	1	64
CO2-PO	43	9	13
CO3-PO	0	3	62
CO4-PO	32	12	21
CO5-PO	1	0	64
CO6-PO	1	0	64

**Table 3: Example of single CO identified to address a subset of Pos.**

CO-PO mapping	Program Outcomes	Representative questions showing correlation between CO-PO
CO 1 PO1	Pharmacy Knowledge	Discuss the concepts of preformulation.
CO1 PO2	Planning ability	Draw the Routes of administration and its influence on dosage form performance.
CO1 PO3	Problem analysis	Discuss the technical issues and therapeutics issues need to be considered during dosage form design.
CO1 PO4	Modern tool usage	Demonstrate the use of bulk density apparatus, IR, DSC and UV spectroscopy in preformulation studies.
CO1 PO5	Leadership skill	Perform experiments showing influence of various additives on dosage form design and stability.
CO1 PO6	Professional identity	Summarize the significance of drug and excipient properties in formulation development.
CO1 PO7	Pharmaceutical ethics	as per pharmacopeia and International Pharmaceutical Excipient Council discuss excipient evaluation and drug evaluation guidelines for solid dosage form.
CO1 PO8	Communication	From the poison ratio explain the significance of lubricant in tablet dosage form.
CO1 PO9	The pharmacist and society	Enlist the precautionary measures to be taken during handling of drug and excipient in dosage form development.
CO1 PO10	Environment and sustainability	Discuss the effect of environment on the stability of drug and excipient properties.
CO1 PO11	Lifelong learning	Appraise the compatibility and stability of newly developed excipients with existing drug candidates and excipients.

It is feasible to determine the degree of mapping (1, 2 and 3) to POs or the reached intended blooming level based on the quantity of COs and the terms (Equipment/Processes) devoted to them.

Based on strength of selected POs, a CO-PO matrix can be established.

CO-PO mapping should be done in such a way that; all stakeholders' participation is ensured.

Stakeholders listing can be Internal (Faculty, Student) and External (Employer, Industry, Alumni, Tier-I Faculty, Conference/Journal Papers/Authors) as shown in Table 4.

For attainment, learning of students should be measured and evaluated. Based on students learning (Active/Passive), direct

(active) and indirect (passive) assessment methods are required to be formulated.<sup>14</sup>

If classroom like environment is created for studying of specific module/course along with university like evaluation, it can be then augmented as direct attainment with 80% claim.<sup>14</sup>

Indirect attainment also can be claimed to be 20% for curriculum and raised up to 50% for feeling up gaps in curriculum.<sup>17</sup>

For CO mapping to PO5 to PO11, faculty should refer journal and conference papers, employer's website, campus placement papers, pre placement talks, competitive exam test papers, offline campus recruitment procedures, desirable profiles required by employers etc, specific to their subject.



Various indirect assessment tools like Focused listing, application cards, standardized tests, list, empty outline, memory matrix, minute paper, muddiest points, one sentence summary, pro-con grind, chain listing, punctuation pauses etc should be evaluated and used judiciously for mapping and attainment.

Each CO should be mapped with specific employment opportunity through off-campus opportunities like employment news and job portals like naukri.com, indeed.com.

Faculty should ensure that all COs should be mapped with at least one subset of each POs. e.g. CO1 should be mapped with at least one subset of PO6 (safety, health, legal and culture).

Every course in curriculum should form CO-PO matrix instead of formulating in similar subject.

Even, two different faculties teaching same subject should form different CO-PO matrix as it is indicative of the learning process to be inculcated in students, as elaborated in Tables 2 and 5.<sup>18</sup>



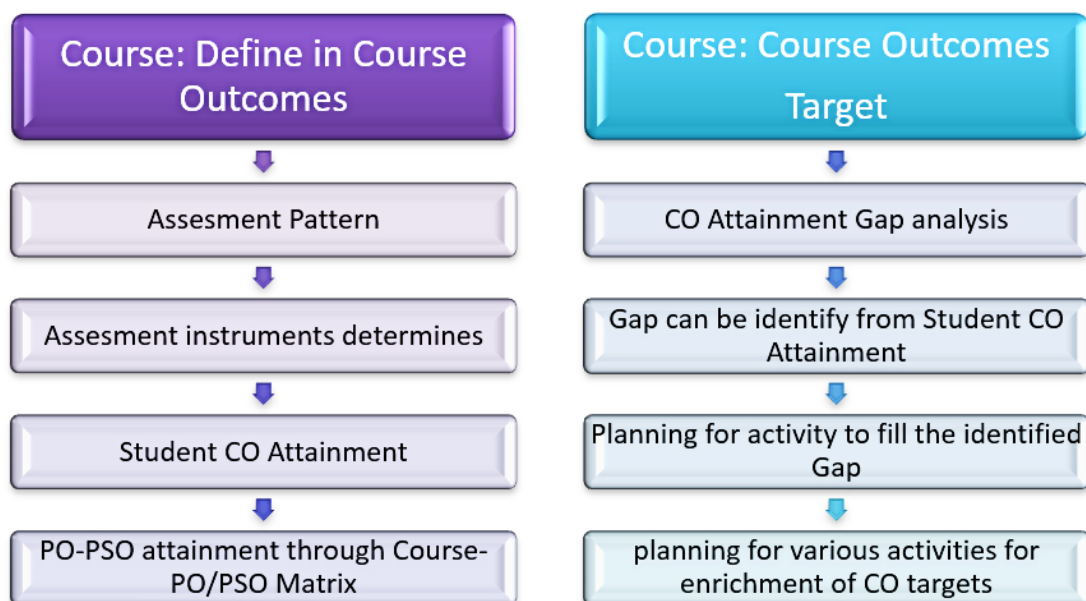
Figure 3: Improvement/action plan to be taken to improve the attainment level of subject.<sup>14</sup>

Table 4: Stakeholder Participation and Assessment tools.

Co-PO mapping	Stakeholder Participation	Assessment Tool	
		Direct/ Indirect	Tool used
CO 1 PO1	Employer	In Direct	Flip classroom
CO1 PO2	Employer	Direct	Flow chart
CO1 PO3	Industry	Direct	Listing
CO1 PO4	Industry	Direct	Experimental
CO1 PO5	Journal	Direct	Experimental
CO1 PO6	Journal	In Direct	Games
CO1 PO7	Pharmacopoeia	In Direct	Games
CO1 PO8	Industry	Direct	One Sentence Summary
CO1 PO9	Excipient council guidelines.	Direct	Listing
CO1 PO10	C GMP and environment protection act guidelines.	In Direct	standardized tests
CO1 PO11	ICH stability guidelines.	In Direct	Campus placement papers, pre-placement talks, competitive exam test papers.

**Table 5: CO Mapping with POs from 5 to 11.**

Unit	CO	Leadership	Professional identity	Ethics	Communication	Pharmacist and Society	Environment and sustainability	Lifelong learning		
Preformulation	CO1	Group activities like seminars and group discussion	Industrial training	European medicine agency guidelines for manufacturing of finished dosage forms <a href="https://www.ema.europa.eu/en/documents/scientific-guideline/guideline-manufacture-finished-dosage-form-revision-1_en.pdf">https://www.ema.europa.eu/en/documents/scientific-guideline/guideline-manufacture-finished-dosage-form-revision-1_en.pdf</a> .	Journal writing and presentation of papers in journal club activity by going through recent articles.	Community Pharmacy activities like counselling for Direction for use and predicting possible incompatibilities if consumed with other dosage form.	C-GMP guidelines, ICH guidelines.	Swayam courses Industrial Pharmacy-I, USP recent updates.		
Formulation and evaluation of Tablet and liquid.	CO2									
Formulation and evaluation of Capsules and pellets.	CO3									
Formulation and evaluation of Parentrals.	CO4								Who guidelines for parentrals: <a href="https://www.who.int/docs/default-source/medicines/norms-and-standards/guidelines/production/trs961-annex6-gmp-sterile-pharmaceutical-products.pdf">https://www.who.int/docs/default-source/medicines/norms-and-standards/guidelines/production/trs961-annex6-gmp-sterile-pharmaceutical-products.pdf</a> .	Swayam Udemy, Pharm Manufacturing training courses.
Formulation and evaluation of Cosmetics.	CO5								FDA guidelines for cosmetics: <a href="https://www.fda.gov/cosmetics/cosmetics-labeling-regulations/summary-cosmetics-labeling-requirements">https://www.fda.gov/cosmetics/cosmetics-labeling-regulations/summary-cosmetics-labeling-requirements</a> .	Courses of Institute of Good Manufacturing Practices India (IGMPI).
Formulation and evaluation of Aerosols and Packaging.	CO6								A guide by American association for respiratory care <a href="https://www.aarc.org/wp-content/uploads/2015/04/aerosol_guide_rt.pdf">https://www.aarc.org/wp-content/uploads/2015/04/aerosol_guide_rt.pdf</a> .	

**Figure 4:** CO formulation, selection of assignments for attainment of CO and Gap Analysis for defining Gap and planning for activities.<sup>15</sup>

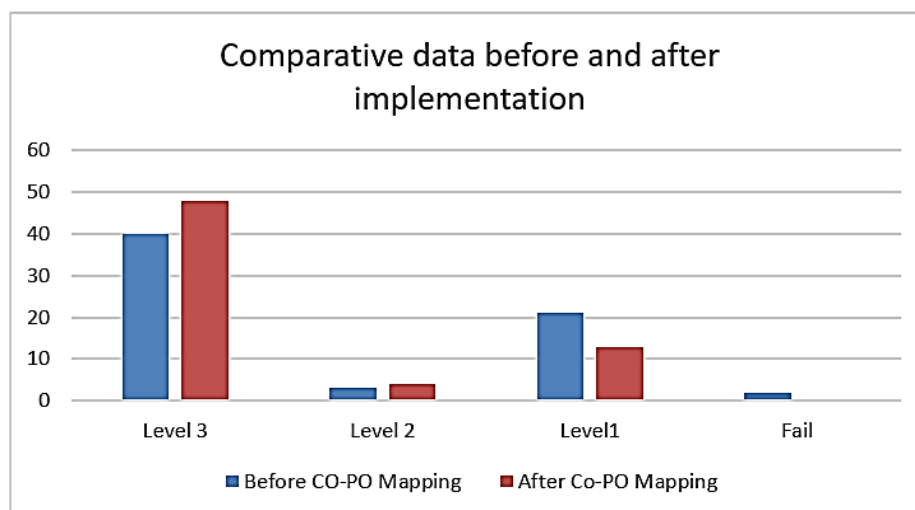


Figure 5: Comparative data before and after implementation of CO-PO mapping.



Figure 6: Stakeholder expectations.

Further we think if we share the data of CO-PO with students and gaps to be filled we think students will themselves get motivated and this in turn may help to a bridge the gap in attainment. The major issue faced currently by students is involvement in all the activities due to hectic academic schedule. When we compare stakeholder expectations we can find those expectations match the POs that are given by NBA (Figure 6) in turn it also meets to employers requirement, based on this data further we can extend the work to check the students willingness to work beyond working hours, his interest to attempt the questions related to employability other than university questions and faculty involvement in these aspect.

## CONCLUSION

The faculty's understanding of how to enhance students' professional skills is reflected in their CO-PO achievement. It is advised that each faculty perform CO-PO mapping and

accomplishment for each topic. Students were expected to turn in this finished booklet as part of their assignment in order to achieve their goals. This also indicates applicability of Outcome Based Education (OBE) as students are welcoming any extra efforts for achievement of desirable outcomes.

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## CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.



## ABBREVIATIONS

**NBA:** National Board of Accreditation; **PEO:** Programme Educational Objectives; **PO:** Programme Outcomes; **CO:** Course Outcomes; **UGC:** University Grants Commission.

## SUMMARY

The attainment is calculated at the program and course levels using the suggested approach. The document that is being presented goes into detail about the process used to create learning objectives and course outcomes that align with the program's educational goals. Professional development opportunities must be combined with innovative teaching and learning strategies for students in order to realise this new vision. Traditional methods of teaching and learning must be changed in order to reform technical education, which has placed a strong emphasis on teaching all students important disciplinary core ideas along with scientific and engineering practices through case studies, demonstration, free online courses and hands-on training. The attainment is calculated at the program and course levels using the suggested approach. Additionally, it provides proof of the alignment between program and course outcomes.

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