



A Comprehensive Methodology For Measuring Course, Program, And Program-Specific Outcomes In Higher Education

Dr. Dattatraya Parhad^{1*}

^{1*}Department of Mathematics and Statistics, Rizvi College of Arts, Science and Commerce Bandra West Mumbai 400050, Affiliated to University of Mumbai. Tel: +91 9657725810 E-mail: parhadd@rizvicollege.edu.in

Citation: Dr. Dattatraya Parhad, (2023), A Comprehensive Methodology For Measuring Course, Program, And Program-Specific Outcomes In Higher Education, *Educational Administration: Theory and Practice*, 29(4), 1996-2000

Doi: 10.53555/kuey.v29i4.6806

ARTICLE INFO

ABSTRACT

The accurate measurement of Course Outcomes (CO), Program Outcomes (PO), and Program Specific Outcomes (PSO) is crucial for continuous improvement in educational programs. Traditional methods often lack the precision and comprehensive analysis required to fully assess these outcomes. This paper proposes a novel methodology that integrates advanced statistical techniques with qualitative assessment tools to provide a more robust framework for measuring CO, PO, and PSO attainment. The proposed methodology aims to enhance the accuracy, reliability, and validity of the assessment processes in higher education institutions.

Keywords: Course Outcomes (CO), Program Outcomes (PO), Program Specific Outcomes (PSO), Educational Assessment, Quantitative Metrics, Qualitative Assessment, Mixed-Methods Approach, Higher Education, Learning Outcomes, Curriculum Design, Statistical Techniques, Continuous Improvement, Holistic Evaluation, Accreditation

1. Introduction

Ensuring that learners achieve desired learning outcomes is paramount in higher education. Course Outcomes (CO), Program Outcomes (PO), and Program-Specific Outcomes (PSO) are key indicators of educational effectiveness. However, current measurement practices often face challenges related to standardization, accuracy, and comprehensive assessment. This paper introduces a new methodology designed to address these challenges, offering a more holistic and precise approach to outcome measurement.

1.1 Problem Statement

Existing methods for measuring CO, PO, and PSO attainment often fall short in providing detailed and accurate analysis. Issues such as lack of standardization, insufficient data integration, and inadequate consideration of qualitative factors lead to incomplete assessments. A methodology that incorporates quantitative metrics and integrates qualitative evaluations is needed to better capture the multifaceted nature of educational outcomes.

1.2 Importance of the Problem

Accurate assessment of CO, PO, and PSO is fundamental to maintaining and enhancing the quality of education. These measurements are essential for accrediting bodies, curriculum developers, and educators to ensure that educational programs meet their objectives and effectively prepare learners for their future careers. Inaccurate or incomplete assessments can lead to a misalignment between educational goals and actual student performance, ultimately affecting the institution's reputation and learners' professional readiness. By developing a more reliable and comprehensive methodology, we can significantly improve quality assurance processes in higher education.

1.3 Objectives

1. To develop a comprehensive framework for measuring CO, PO, and PSO attainment.
2. To enhance the accuracy, reliability, and validity of outcome measurement processes.
3. To provide actionable insights for continuous improvement in educational programs.

2. Review of Literature

2.1 Literature review

The literature on educational assessment highlights various methodologies for measuring learning outcomes. Traditional approaches often rely heavily on quantitative metrics such as exam scores and survey results. However, recent studies suggest that combining quantitative data with qualitative evaluations, such as student feedback and peer reviews, can provide a more nuanced understanding of outcome attainment. This paper builds on these insights, proposing a methodology that leverages both types of data to offer a more comprehensive assessment framework.

2.2 Relation to Previous Work

Previous research has predominantly focused on quantitative measures, with studies by Biggs and Tang (2011) and Black and Wiliam (1998) emphasizing metrics such as test scores and course completion rates. However, these approaches often overlook the rich, contextual information that qualitative data can provide. Creswell and Creswell (2017) highlighted the potential of mixed-methods approaches, combining qualitative and quantitative data to enhance assessment depth and breadth. This paper extends these insights by integrating advanced statistical techniques with qualitative assessments to create a more robust and holistic methodology for measuring CO, PO, and PSO attainment.

3. Research Methodology

3.1 The Methodology in Practice

In the recent years, the institutions are measuring the CO/PO/PSO attainment in which the attainment level is calculated in three parts

- (i) CO attainment at Semester End Examination (SEE)
 - (ii) CO attainment at Continuous Internal Assessment (CIA)
 - (iii) CO attainment level in Course exit survey
- The steps involed in the process are as follows: -

a) Design of CO and PO/PSO with the help of Bloom's Taxonomy

The CO's are designed based on the expectations from the learner after completing the course. It explains what knowledge gained by the student, what is the understanding level achieved by the learner, what skills are developed by the learner, how the learner can apply the knowledge for a creation purpose

b) Mapping of CO and PO/PSO using the known correlations between them

The facilitator decides the correlation between the CO and PO/PSO on the three-level scale, based on the understanding and experience of the facilitator.

Level 1: if there is slight correlation
 Level 2: if there is moderate correlation
 Level 3: if there is strong correlation
 Level 4: if there is no correlation

c) Course attainment level calculations

The facilitator then analyse the question paper and Marksheet of Semester end exam for the mapping of questions with Cos and the number of learners who score the marks in that question more or equal to the desire (p%). The CO is supposed to be attained if the student scores more or equal to p%. The attainment level is calculated by the formula:

$$\begin{aligned} & \text{Percentage of leaners who attained the CO(a)} \\ & = \frac{\text{Number of learners who score more or equal to p\%}}{\text{Total number of learners who attempted the question}} \times 100 \end{aligned}$$

The facilitator then decides the CO attainment level with following criteria: Level 1: $0 \leq a < q$

Level 2: $q \leq a < r$

Level 3: $r \leq a \leq 100$

The percentages p, q and r are to be decided by the facilitator according the difficulty level of the course and question paper as well as the academic, social and financial background of the learners.

d) PO/PSO attainment level calculations

PO/PSO attainment can be computed for a batch using following formula:

$$\text{PO / PSO ATTAINMENT} = \frac{(\text{CO attainment} * \text{Co} - \text{PO/PSO mapping})}{\text{maximum correlation strength}}$$

3.2 Proposed Methodology and Theoretical Implications

The proposed methodology involves a multi-step process:

a) Design of CO and PO/PSO with the help of Bloom's Taxonomy

The facilitator will decide the Course outcomes depending upon the level achieved by the learner on the scale of Bloom's taxonomy from L1 to L6 as follows:

L1: Remember

L2: Understanding L3: Apply

L4: Analyse L5: Evaluate L6: Create

Maximum six Course outcomes will be designed on the basis of expected level of achievement on the completion of the course.

b) Mapping of CO and PO/PSO using the known correlations between them

The facilitator will rate the CO with PO/PSO on the scale of 0 to 1, both inclusive, say l1 to l6 depending upon the strength of relationship between each CO with each PO/PSO. The table will have all the column sums equal to 1.

c) Course attainment level calculations

The facilitator then analyse the question paper and Marksheet of Semester end exam for the mapping of questions with COs and the number of learners who score the marks in that question more or equal to the average marks. The level of attainment of CO will be categorized as follows:

Level 1: $\alpha\%$ of the learners scored marks more or equal to the average marks obtained by the learners
Level 2: $\beta\%$ of the learners scored marks more or equal to the average marks obtained by the learners
Level 3: $\gamma\%$ of the learners scored marks more or equal to the average marks obtained by the learners

d) PO/PSO attainment level with each Course

Calculate the data for the calculation of PO/PSO attainment as follows:

S1: If p% of learners scored the marks more or equal to the average marks in Question related to CO1
S2: If p% of learners scored the marks more or equal to the average marks in Question related to CO2
S3: If p% of learners scored the marks more or equal to the average marks in Question related to CO3
S4: If p% of learners scored the marks more or equal to the average marks in Question related to CO4
S5: If p% of learners scored the marks more or equal to the average marks in Question related to CO5
S6: If p% of learners scored the marks more or equal to the average marks in Question related to CO6
PO/PSO attainment can be computed for a batch using following formula:

$$\text{PO/PSO ATTAINMENT} = \frac{\sum l.s}{\sum l}, \sum l = 1$$

Here are a few specific recommendations while applying this method:

1. Consistency in scales: Ensure that the scales used for correlation and attainment levels are consistent throughout the methodology.

2. Clear definitions: Clearly define and justify the scales and criteria (e.g., values of p, q, r, α , β , γ and the maximum correlation strength).

3. Sum of the correlations: The column sum represents the total contribution of each course outcome amongst the PO/PSO of the program. So, the Sum of all these correlation coefficients needs to be 1 for the uniformity and it is also requirement of the statistical tool. The facilitator needs to make sure that the column sum must be equal to 1.

e) Over-all PO/PSO attainment Level

The facilitator can frame a table showing the correlation strength of each course with each of the PO/PSO. Let the correlation strengths of the PO/PSO are denoted by C1, C2 etc. where the column sum must be equal to 1 and the corresponding PO/PSO attainment levels are denoted by L1, L2, etc.

The over-all PO/PSO attainment level can be calculated as follows:

$$\text{Over-all PO/PSO attainment} = \frac{\sum C.L}{\sum C}, \sum C = 1$$

The same methodology can be adopted for the Internal as well as the Semester end examination and Final PO/PSO attainment level can be calculated by the formula

$$\text{Final PO/PSO attainment} = x \times a + y \times b$$

where x, y denotes weightages for the Internal and Semester examinations and a, b denotes the over-all

attainment in internal and Semester examination respectively.

4. Conclusions:

4.1 Summary of Conclusions

In this research, I have examined the current practices for measuring the attainment of Course Outcomes (CO), Program Outcomes (PO), and Program Specific Outcomes (PSO) within educational institutions. The existing methodology, which involves the calculation of attainment levels based on Semester End Examinations (SEE), Continuous Internal Assessment (CIA), and Course Exit Surveys, has provided a structured approach to evaluating student performance. However, it has revealed areas for potential enhancement.

The proposed methodology builds upon the foundation of Bloom's Taxonomy, utilizing a systematic approach to design COs and PO/PSOs, map them accurately, and calculate attainment levels with greater precision. By introducing a refined correlation scale and employing a comprehensive method for evaluating student performance through various assessment metrics, this methodology aims to provide a more detailed and nuanced understanding of learner achievements.

Key improvements in the proposed methodology include:

1. **Enhanced CO and PO/PSO Design:** By leveraging Bloom's Taxonomy, the COs are crafted to reflect a comprehensive range of cognitive skills, from basic knowledge recall to complex creation and evaluation tasks. This ensures that the learning outcomes are aligned with the expected educational objectives and skillsets required in real-world applications.
2. **Accurate Correlation Mapping:** The introduction of a more granular scale for mapping COs to POs/PSOs allows for a more precise assessment of the relationships between course outcomes and program objectives. This helps in identifying specific areas where the curriculum can be improved to better align with program goals.
3. **Refined Attainment Level Calculations:** The new criteria for determining attainment levels based on average marks provide a clearer and more standardized measure of student performance. This adjustment addresses the variability in difficulty levels across different courses and assessments, leading to more reliable attainment data.
4. **Comprehensive PO/PSO Attainment Calculation:** The revised formula for calculating PO/PSO attainment incorporates multiple data points, ensuring that the overall program outcomes are reflective of a diverse range of student achievements across various COs. This holistic approach offers a more accurate depiction of program effectiveness.

In conclusion, the proposed methodology offers a robust framework for assessing educational outcomes with improved accuracy and detail. By adopting this approach, institutions can gain deeper insights into student performance, enabling targeted interventions and curriculum enhancements to foster better educational outcomes. This refined methodology not only supports continuous improvement in teaching and learning processes but also ensures that educational programs remain aligned with the evolving needs of learners and the demands of the professional landscape.

4.2 Practical Implications

Implementing the proposed methodology has several practical implications for higher education institutions. Firstly, it can enhance the accuracy and reliability of outcome assessments, providing a clearer picture of student learning and program effectiveness. This, in turn, can help institutions make more informed decisions about curriculum design and teaching strategies. Secondly, the methodology's integration of qualitative data ensures that the assessments are more holistic, capturing the full spectrum of student experiences and learning outcomes. Lastly, the actionable insights derived from this comprehensive assessment can guide targeted interventions, ultimately leading to improved educational quality and student performance. Institutions can also use the findings to meet accreditation requirements more effectively and demonstrate their commitment to continuous improvement.

Acknowledgements:

I would like to express my gratitude to my colleagues at the Department of Mathematics and Statistics, Rizvi College of Arts, Science and Commerce, for their support and contributions to this research. Special thanks to the learners who participated in the pilot study, providing invaluable feedback and data.

References

1. Biggs, J., & Tang, C. (2011). *Teaching for Quality Learning at University*. McGraw-Hill Education.
2. Black, P., & Wiliam, D. (1998). *Assessment and Classroom Learning*. *Assessment in Education: Principles, Policy & Practice*, 5(1), 7-74.
3. Creswell, J. W., & Creswell, J. D. (2017). *Research Design: Qualitative, Quantitative, and Mixed Methods Approaches*. Sage publications.
4. Anderson, L. W., & Krathwohl, D. R. (2001). *A Taxonomy for Learning, Teaching, and Assessing: A Revision of Bloom's Taxonomy of Educational Objectives*. Longman.