

A Comprehensive Platform for Enhancing the Achievement of Program Learning Outcomes and Advancing Academic Quality Assurance

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Abstract

This article presents EVALLOS, a comprehensive platform for assessing the achievement of Program Learning Outcomes (PLOs) and supporting academic quality assurance in higher education. The platform implements a multi-level learning analytics workflow that maps assessment items to Course Learning Outcomes (CLOs), aggregates CLO results across classes and courses, and computes program-level PLO attainment indicators. Bloom-based rubrics are employed to capture both lower-order and higher-order cognitive skills, while a CLO-PLO alignment matrix enables systematic aggregation of course results to the program level. This study focuses on the design and operationalization of accreditation-oriented indicators that support evidence-based quality assurance and continuous improvement in alignment with international frameworks such as ABET, AUN-QA, and FIBAA. The system was deployed in a Vietnamese university, where the results indicate improved transparency in outcome evaluation and more focused curriculum improvement actions driven by program-level analytics and stakeholder feedback.

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1 Introduction

Recent reforms in Vietnamese higher education have placed increasing emphasis not only on the definition of student learning outcomes (SLOs), but also on providing convincing evidence that program learning outcomes (PLOs) are being systematically achieved. Accreditation agencies require robust documentation of how course level assessments are aggregated and used for program level decision making. However, most existing information systems still treat assessment data as isolated scores at the course level, which creates

gaps between classroom practice and program accreditation reports.

These issues can only be addressed by having a better and more comprehensive framework for evaluating SLOs. This kind of framework must go beyond the reliance on numbers like test scores alone to involve means of measuring things like experiences and feelings. Observation, portfolios, and feedback from stakeholders are some of the methods that can give us a true idea of how our students are doing related to program level learning [1]. If these means are utilized,

universities can move toward fact-based decisions about their curricula, teaching, and assessment methodologies. In this way, their educational programs would remain relevant and of high quality over time. It aims to establish a coherent system through which various SLOs assessment data are collected, processed, and reported. This system aims to provide universities with more specific details on how well their students are achieving the set program level learning results. In this way, it will be easier for curriculum developers to implement changes and enhance training programs. The application of such technology in colleges and universities in Viet Nam will enhance their output quality by ensuring that these programs maintain their relevance to set training goals and meet the needs of the students [1]. Researchers have also established a very valuable framework for assessing outcome standards at the student and subject levels based on the analysis of various techniques for measuring student and subject learning outcomes [1]. The framework will serve as the foundation for the design of EVALLOS system that is intended to ease and enhance the assessment of learning outcomes in universities.

A preliminary version of EVALLOS platform, focusing primarily on course learning outcome (CLO) and student learning outcome (SLO) assessment at the course level, was previously reported in a conference paper presented at ATAC 2024 [2]. In addition, a companion journal article has described the core data-processing architecture and AI-driven reporting mechanisms of EVALLOS [3]. The present article complements these prior publications by shifting the focus to accreditation-oriented indicators and a program-level analytics workflow that supports evidence-based academic quality assurance. In particular, this study emphasizes how CLO-level evidence is systematically aggregated to demonstrate PLO attainment, how these indicators align with international accreditation frameworks, and how the resulting analytics support continuous improvement processes at the program level. Technical details of automated reporting and AI-assisted content generation are outside the scope of this article and are discussed in [3]. The main contributions of this article are threefold:

- (1) We design and implement a multi-level analytics workflow that aggregates CLOs results across classes and courses to estimate PLO attainment at the program level.
- (2) We operationalize accreditation-oriented indicators that connect EVALLOS reports with the expectations of ABET, AUN-QA and FIBAA.
- (3) We report empirical findings from the deployment of EVALLOS in a real higher education context and discuss its implications for academic quality assurance and continuous improvement.

2 Literature Review

2.1 International Accreditation Standards for Evaluating Educational Outcomes

The standards of international accreditation are an important aspect in ensuring the quality of higher education programs delivered worldwide. Through the effective utilization of frameworks, the standards serve to facilitate the assessment, quantification, and enhancement of the programs' CLOs and PLOs for the institutions. A number of prestigious organizations contributing to the quality of high education programs delivered worldwide are ABET (Accreditation Board for Engineering and Technology) [4], AUN-QA (ASEAN University Network Quality Assurance)[5], and FIBAA (Foundation for International Business Administration Accreditation) [6], among others, who utilize distinct approaches for the assessment of their results in the field of education.

ABET accredits programs in technology, computer engineering, and science to ensure graduates meet social and industrial needs [4]. Its framework emphasizes clear goals and outcomes, program development, and adequate support services, assessed through self-evaluation, peer review, and continuous improvement [4]. ABET accreditation also provides global recognition and supports ongoing curriculum updates to keep pace with technological change [4].

AUN-QA aims to harmonize higher education standards across ASEAN and ensure programs remain relevant to labor market needs [5]. Accreditation typically involves institutional self-assessment followed by external reviews, including stakeholder interviews and checks on alignment between teaching,



learning, and outcomes [5]. It also supports regional cooperation and continuous improvement to strengthen graduate readiness [5].

FIBAA focuses on accrediting higher education programs in business administration, social sciences, and law [6]. Its process typically includes institutional self-assessment and external site visits to review how learning goals are planned, implemented, and evidenced through teaching, assessment results, and quality assurance practices [6].

ABET, FIBAA, and AUN-QA informed the development of EVALLOS by shaping its alignment and quality assurance approach. In particular, AUN-QA emphasizes constructive alignment between learning objectives and CLOs/PLOs, while ABET highlights evidence-based assessment and performance indicators for continuous improvement. FIBAA reinforces the role of self-assessment and reporting to support ongoing program enhancement. Together, these perspectives help EVALLOS align outcome evaluation with international quality benchmarks.

2.2 Global Methodologies for Evaluating Educational Output Standards

OBE emphasizes explicit identification of learning outcomes and the focus of all learning processes toward the realization of the stipulated learning outcomes [7]. Most modern accreditation standards such as ABET and AUN-QA operate using the principle of OBE. It emphasizes the close linkage between PLOs and CLOs and provides encouragement for a continuous improvement process through collection and analysis of data from the stakeholders, including teachers and students, as well as business partners to ensure that training objectives remain helpful and relevant to the needs of today's working environments [7].

Performance Indicators are quantitative and qualitative measures used to determine whether learning goals have been achieved [8]. In Viet Nam, program indicators are employed in higher education institutions such as Lac Hong University to establish how CLOs and PLOs deliver combined positive outcomes with the aim of further improving their curriculum. Benchmarking is the process whereby an institution measures its performance against those of similar institutions or other global

standards aimed at assurance of quality and continuous improvement. This method helps schools find their strengths and weaknesses so that they can meet or exceed international educational standards [8].

Rubrics are detailed modes of evaluation that designate standards on how to judge the performance of students on specific assignments [9]. They make an assessment more open and fair to students by giving them feedback on what they are doing. Rubrics are excellent in measuring soft skills such as teamwork and communication, which employers look for after graduation [9]. Rubrics help students understand what is expected of them and show them how to reach the skills they want by giving clear standards [9].

3 Materials and Methods

3.1 System Design

EVALLOS is designed as a data-driven platform that collects assessment records, outcome mappings, and rubric-based evaluations to compute CLO and PLO attainment indicators. The overall platform architecture and AI-driven reporting pipeline are described in detail in [3]. Here, we summarize the components necessary to operationalize accreditation-oriented indicators and to support program-level quality assurance analysis.

Input requirements: In order to assess student performance and determine if the CLOs have been achieved, data must be collected on grade distribution, including the number of participants and student scores. These provide an opportunity to take a closer look at performance across courses and form the basis for determining the extent to which the CLOs have been achieved. Furthermore, it is important to establish specific objectives for PLOs and CLOs. The objectives establish a basis against which performance or achievements are measured and guide efforts towards improvement.

3.2 Applying Bloom's Taxonomy for Evaluation

In EVALLOS, Bloom's Taxonomy is used as a structural basis for designing assessment rubrics. Each assessment item is associated with rubric levels that reflect different cognitive complexity levels, allowing the system to distinguish between lower-order and higher-order learning outcomes. These rubric levels are stored together with item scores and are used to support



threshold-based attainment evaluation at both the CLO and PLO levels [10, 11].

3.3 CLO attainment workflow

After defining the overall system architecture and the set of CLOs for each course based on Bloom's taxonomy, EVALLOS performs a structured workflow to compute CLO attainment indicators from raw assessment data.

For each course, instructors first create a bank of assessment items, such as exam questions, quizzes, assignments or project components. Each item is associated with one or more CLOs through a binary or weighted mapping. In the binary case, a value of 1 indicates that an item contributes to a given CLOs and 0 otherwise. In the weighted case, instructors can specify different contribution weights when an item is designed to address multiple CLOs with different levels of emphasis.

Let $Q = \{q_1, q_2, \dots, q_m\}$ denote the set of assessment items and $C = \{c_1, c_2, \dots, c_n\}$ the set of CLOs of a course. The item to CLO mapping is represented by a matrix $M \in \mathbb{R}^{m \times n}$, where M_{ij} is the contribution weight of item q_i to CLO c_j . In the simplest case, $M_{ij} \in \{0,1\}$.

For each student attempt on an item, EVALLOS stores the awarded score together with the maximum possible score and the rubric level that characterizes the quality of the answer. Based on these records, the platform computes item level indicators such as:

- The average score and standard deviation
 - The proportion of students who achieve at least a given percentage of the maximum score
 - The distribution of rubric levels reached by the cohort
- These indicators are then propagated from items to CLOs using the mapping matrix. A typical aggregation function for CLOs c_j can be written as

$$A_{c_j} = \frac{\sum_{i=1}^m M_{ij} \cdot s_i}{\sum_{i=1}^m M_{ij} \cdot s_i^{\max}},$$

where s_i and s_i^{\max} denote the average obtained score and the maximum possible score of item q_i , respectively. This expression yields a normalized attainment value in the interval [0, 1] or [0, 100] when expressed as a percentage.

In practice, institutions may prefer to work with rubric based thresholds instead of raw percentages. Therefore, EVALLOS allows administrators to define a set of attainment levels such as "not attained", "partially attained", "attained" and "exceeded". Each level corresponds to a score range or to a combination of rubric levels. After computing the normalized attainment value for each CLO, the platform assigns the appropriate attainment level according to these thresholds.

The resulting CLO indicators are visualized in multiple ways. At the class level, instructors can inspect bar charts and tables that show, for each CLO, the percentage of students who surpass the minimum acceptable level, as well as the distribution of rubric levels. At the course level, coordinators can compare CLO attainment across different class sections and semesters. These visualizations help identify CLOs that consistently underperform and may require revision of teaching activities, assessment design or rubric descriptors.

The overall logic of this CLO attainment workflow is consistent with our previous conference work on EVALLOS, in which we introduced the basic calculations and examples using a smaller dataset. In the present article, this workflow serves as the foundation for higher level analyses at the PLO and accreditation level.

3.4 PLO aggregation and accreditation-oriented indicators

The main methodological extension in this article lies in the way EVALLOS aggregates CLOs results to estimate PLO attainment at the program level and in how it transforms these results into indicators that are directly usable for accreditation and quality assurance. Each program specifies a set of PLOs that describe the expected competencies of graduates. For every course in the curriculum, course coordinators define how the course CLOs contribute to these PLOs through a CLOs-PLOs mapping matrix. Let $P = \{p_1, p_2, \dots, p_k\}$ denote the set of PLOs and A^{CLO} the vector of CLO attainment values for a given course. The CLOs-PLOs mapping is encoded in a weight



matrix $W \in \mathbb{R}^{n \times k}$, where W_{jk} indicates the degree to which CLO c_j contributes to PLO p_k .

For each course, EVALLOS computes a course level contribution to PLO attainment as

$$A_{\text{course}}^{\text{PLO}} = g(A^{\text{CLO}}, W),$$

where $g(\cdot)$ is an aggregation function configured by the program. A common choice is a weighted average

$$A_{\text{course}, p_k}^{\text{PLO}} = \frac{\sum_{j=1}^n W_{jk} \cdot A_{c_j}}{\sum_{j=1}^n W_{jk}},$$

which intuitively states that the attainment of a PLO is a weighted combination of the attainment of the CLOs that contribute to it. Other schemes such as taking the minimum of contributing CLOs or combining rubric based categories are also supported to match institutional policies.

At the program level, the platform aggregates the contributions of all relevant courses. Depending on the institution, this can be done per cohort, per intake or across multiple intakes. If \mathcal{C}_k denotes the set of courses that contribute to PLO p_k , a simple aggregation across courses can be expressed as

$$A_{\text{program}, p_k}^{\text{PLO}} = h(\{A_{\text{course}, p_k}^{\text{PLO}} \mid \text{course} \in \mathcal{C}_k\}),$$

where $h(\cdot)$ is an aggregation function such as an average weighted by enrolment size. This computation yields program level PLO attainment indicators that can be compared with institutional targets.

To make these indicators meaningful for accreditation, EVALLOS organizes them into dashboards that mirror key questions of frameworks such as ABET, AUN-QA and FIBAA. For each PLO, the platform provides:

- Current attainment values and attainment level according to predefined thresholds
- Trend lines across several recent cohorts to support continuous improvement evidence
- The list of courses and CLOs that contribute to the PLO, with their individual attainment values
- Counts of improvement actions that were triggered by low PLO attainment and their follow up status

These elements allow program committees to see not only whether a PLO is attained, but also how robust this

attainment is over time and which parts of the curriculum are responsible for strengths or weaknesses. In addition, EVALLOS generates ready-to-use tables and figures that can be inserted into self evaluation reports. For example, a program can export a summary table that shows, for each PLO, the attainment value of the last three cohorts, the threshold used to judge acceptability, and the main actions taken when attainment fell below the target.

By integrating course level CLO attainment, program level PLO aggregation and accreditation-oriented indicators into a single workflow, the methodology implemented in EVALLOS closes the gap between classroom assessment and institutional quality assurance. It enables stakeholders at different levels, from instructors to program coordinators and quality assurance units, to rely on a common data infrastructure and a shared set of indicators when making decisions about curriculum design, teaching improvement and external accreditation.

4 Results

EVALLOS supports CLO assessment through the Exam Teams Management Interface, where instructors organize assessments (e.g., midterms, finals, presentations) and link each question to CLOs using a Question-to-CLO mapping matrix. The system aggregates student results and computes CLO attainment rates using standard formulas, enabling comparison across exam teams to identify strengths and weaknesses. As shown in Table 1, all three CLOs in Assessment Group A met the predefined attainment threshold, with an average score of 20/33 (60.6%). MCQ5 exhibited the highest attainment (88.9%), while MCQ2 showed the lowest attainment (31.2%), indicating a potential misalignment between the assessment item and the targeted CLO.

Table 1 Assessment results for CLOs in Assessment Group A

Item	Related CLO	Attainment (%)
MCQ1	CLO1	60.4
MCQ2	CLO2	31.2

MCQ3	CLO2	61.8
MCQ4	CLO3	72.6
MCQ5	CLO3	88.9
Overall (CLO1–CLO3)	—	60.6

Note: Attainment (%) is calculated as the ratio between the average obtained score and the maximum possible score. The predefined attainment threshold is 60%.

At the course level, EVALLOS tracks CLO attainment across multiple class sections and semesters. Through the Courses Management Interface, instructors can manage courses and generate CLO reports showing average CLO scores, attainment percentages, and trend charts, with exports available for further analysis (e.g., Excel). Table 2 summarizes CLO attainment across semesters for the selected course. CLO1 achieved the highest average attainment (76.16%), while CLO2 and CLO3 reached similar levels (75.15%). The results indicate consistent attainment across semesters, with all CLOs meeting the institutional threshold (Pass).

Table 2 CLO attainment across semesters for the selected course (%)

Semester	CLO1	CLO2	CLO3
2023-1	75.1	74.6	74.7
2023-2	76	75	75.1
2024-1	76.8	75.6	75.5
2024-2	76.74	75.4	75.3
Average	76.16	75.15	75.15

Note: All CLOs meet the institutional attainment threshold (e.g., 60%). Values are reported as attainment percentages.

The CLOs-PLOs Mapping tool on the EVALLOS platform ensures that each Course Learning Outcome contributes effectively to the Program Learning Outcomes. As shown in Table 3, the CLOs–PLOs mapping matrix specifies how each CLO contributes to the program PLOs. CLO1 contributes to PLO1 and PLO2, while CLO2 supports PLO2 and PLO3. This matrix helps program teams identify which CLOs and courses are most critical for each PLO and pinpoint

areas that may require additional instructional support to strengthen PLO attainment.

Table 3 CLOs–PLOs mapping matrix for the program

CLO	PLO1	PLO2	PLO3
CLO1	✓	✓	
CLO2		✓	✓
CLO3	✓		✓

Note: A check mark (✓) indicates that the corresponding CLO contributes to the PLO.

EVALLOS evaluates program level PLO attainment by aggregating CLO results across relevant courses and calculating attainment percentages for each PLO. The Program PLO Assessment Results interface then presents these outcomes in tables over semesters/years, helping program coordinators track trends and identify PLOs that decline, which may signal the need to review and revise related courses.

4 Discussion

Findings from the implementation of the EVALLOS system are consistent with existing work on outcome based education and quality assurance. The automation of CLOs-PLOs linkage not only increases transparency but also encourages more active engagement from faculty members, which aligns with previous studies on the value of dashboard based assessment for monitoring performance.

The use of Bloom's Taxonomy in the assessment rubrics brings clearer evidence of students' intellectual skill development. In particular, courses that emphasized higher order categories such as "Analyze/Evaluate" and "Create" showed noticeably higher PLO attainment, which is in line with earlier research on the benefits of Bloom-based rubrics for validity and reliability.

The automated aggregation of multi-class CLO results also supports prior claims that systematic question, outcome mapping enhances confidence in mastery levels compared with ad hoc assessment. In the EVALLOS trial, program chairs reported that curriculum adjustments became "more focused" when guided by these analytics rather than raw grades.

When viewed through the lens of international accreditation frameworks, the role of EVALLOS becomes even more apparent. Stakeholders are more engaged and evaluations more data driven, with stakeholder feedback indicating a higher level of active participation among quality staff and faculty. Automated alerts for declining PLO attainment help trigger timely teaching adjustments, while the combination of quantitative indicators and reflective analysis supports a holistic view of program quality. Overall, the reduction in administrative burden and the support for constructive alignment enable educators to spend less time on reporting tasks and more on designing learning experiences. A platform like EVALLOS, grounded in a comprehensive taxonomy and aligned with accreditation requirements, can contribute to a culture of continuous improvement in higher education. Future work will extend the system to incorporate qualitative artefacts such as portfolios and direct observations, in order to strengthen its diagnostic capabilities in the affective and cognitive domains.

5 Conclusion

This study has presented EVALLOS as a platform for systematically aggregating course-level assessment

evidence to evaluate Program Learning Outcome attainment and to support accreditation-oriented academic quality assurance. By aligning CLO results with program goals through a structured CLO–PLO mapping and by operationalizing accreditation-focused indicators, EVALLOS enables institutions to generate transparent, consistent, and defensible evidence of learning outcome achievement.

Compared with our previous ATAC 2024 conference publication, this extended journal article places greater emphasis on program-level analytics, accreditation alignment, and the role of outcome indicators in supporting continuous improvement processes. The results from a real institutional deployment illustrate how program committees can use these indicators to identify weaknesses, prioritize improvement actions, and document their impact over time.

While EVALLOS is part of a broader digital ecosystem that includes automated reporting components, the contribution of this article lies in its methodological framework for outcome aggregation and accreditation-oriented analysis. Future work will further strengthen this framework by incorporating qualitative artefacts such as portfolios and direct observations to enhance the evaluation of complex learning outcomes.

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Nền tảng nâng cao mức độ đạt chuẩn đầu ra chương trình đào tạo và thúc đẩy đảm bảo chất lượng đào tạo

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Tóm tắt Nghiên cứu này trình bày EVALLOS, một nền tảng toàn diện hỗ trợ đánh giá mức độ đạt được Chuẩn đầu ra chương trình đào tạo (Program Learning Outcomes – PLOs) và tăng cường công tác đảm bảo chất lượng học thuật trong giáo dục đại học. Nền tảng triển khai một quy trình phân tích học tập nhiều tầng, trong đó các mục đánh giá được ánh xạ tới Chuẩn đầu ra học phần (Course Learning Outcomes – CLOs), kết quả CLOs được tổng hợp giữa các lớp và các học phần, từ đó tính toán các chỉ số mức độ đạt PLOs ở cấp chương trình. Các rubric dựa trên thang phân loại Bloom được sử dụng nhằm ghi nhận cả kỹ năng nhận thức bậc thấp và bậc cao, trong khi ma trận liên kết CLO-PLO cho phép tổng hợp kết quả học phần lên cấp chương trình một cách có hệ thống. Nghiên cứu này tập trung vào thiết kế và vận hành các chỉ số hướng tới kiểm định, nhằm hỗ trợ đảm bảo chất lượng dựa trên minh chứng và thúc đẩy cải tiến liên tục, phù hợp với các khung chuẩn quốc tế như ABET, AUN-QA và FIBAA. Hệ thống đã được triển khai tại một trường đại học ở Việt Nam, với kết quả cho thấy tính minh bạch trong đánh giá chuẩn đầu ra được cải thiện, đồng thời các hoạt động điều chỉnh chương trình đào tạo trở nên tập trung và hiệu quả hơn, dựa trên các phân tích ở cấp chương trình và phản hồi của các bên liên quan. Bài báo này mở rộng phiên bản hội nghị và tạp chí trước đó bằng cách nhấn mạnh phân tích ở cấp PLOs chương trình và các báo cáo hướng tới kiểm định chất lượng.

Từ khóa Phân tích dữ liệu học tập, Giáo dục dựa trên kết quả, Ma trận liên kết CLOs-PLOs