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ORIGINAL ARTICLE

Designing and Evaluating the EVALLOS Model for Course Learning Outcome Attainment Measurement and Quality Assurance in Vietnamese Higher Education

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ABSTRACT
Outcome-based education requires higher education institutions to provide evidence of Course Learning Outcome attainment that is transparent, consistent, and suitable for quality assurance and accreditation. In practice, course learning outcome reporting is often computed manually from assessment data, which can be time-consuming and difficult to audit across courses and assessment instances. This study proposes and evaluates a structured model to computing course learning outcome attainment using item-level assessment evidence and explicit item-to-course learning outcome mappings in a Vietnamese university context. The research study was conducted over two consecutive semesters using exam-team assessments (e.g., midterm and end-of-term assignments/papers) that included both score-based items and rubric-based evaluations. Accuracy was examined by comparing computed course learning outcome attainment results with instructor-validated spreadsheet calculations. The findings show close consistency with manual computation and improved traceability from course learning outcome attainment indicators back to assessment evidence, supporting more consistent outcome reporting for internal quality assurance and accreditation preparation. The study highlights the value of item-level course learning outcome attainment analytics as a practical foundation for strengthening outcome-based quality assurance in higher education.

1. INTRODUCTION

1.1. Learning outcomes and quality assurance in Vietnamese higher education

In recent years, outcome-based education (OBE) has become a central principle guiding curriculum design, assessment, and quality assurance (QA) in higher education worldwide. Within this paradigm, learning outcomes provide explicit statements of what students are expected to know and be able to do upon completion of a course or program, thereby serving as a foundation for curriculum alignment, assessment design, and continuous improvement processes (Biggs & Tang, 2011).

In Vietnam, the importance of learning outcomes has been institutionalized through regulatory and accreditation requirements. Circular 17/2021/TT-BGDĐT issued by the Ministry of Education and Training mandates that higher education institutions clearly define Student Learning Outcomes and provide evidence that these outcomes are systematically assessed and achieved across academic programs (MOET, 2021). Compliance with this regulation requires universities not only to articulate learning outcomes at the course and program levels, but also to demonstrate transparent, consistent assessment practices that link student performance to these outcomes.

At the same time, Vietnamese universities face increasing pressure from both national and international accreditation frameworks. Quality assurance standards promoted by organizations such as the ASEAN University Network Quality Assurance (AUN-QA) (AUN-QA, 2023) and the Accreditation Board for Engineering and Technology (ABET, 1932) emphasize constructive alignment between learning outcomes, teaching activities, and assessment evidence, as well as the use of outcome data to inform curriculum improvement and strategic decision-making. These expectations have elevated the role of Course Learning Outcome (CLO) as a key operational unit within QA systems.

Within this context, CLOs function as the primary interface between classroom-level assessment and institutional QA. Reliable measurement of CLO attainment enables QA units to monitor teaching effectiveness, identify areas for curriculum revision, and provide documented evidence for internal review and external accreditation. Consequently, systematic and auditable CLO assessment has become a critical requirement for ensuring educational quality in Vietnamese higher education.

1.2. Limitations of current Course Learning Outcome assessment practices

Despite the growing importance of CLO-based assessment, many higher education institutions continue to rely on practices that present significant limitations for QA. A common approach involves manual aggregation of student scores from examinations and assignments to infer CLO attainment. While this method is straightforward, it is often time-consuming, error-prone, and difficult to audit, particularly when applied across multiple courses, cohorts, and academic units.

Another challenge concerns consistency across departments and programs. In the absence of standardized procedures and analytical frameworks, different faculties may adopt divergent interpretations of CLO attainment thresholds, mapping rules, and reporting formats. Such inconsistencies reduce the comparability of outcome data and weaken its usefulness for institution-wide QA and decision-making.

In addition, although learning management systems are widely used to manage teaching and assessment activities, they typically focus on score recording and grade calculation rather than on transparent outcome analytics. The logic by which assessment items contribute to CLOs and how CLOs relate to higher-level outcomes is often implicit or undocumented, making it difficult for QA stakeholders to verify results or trace evidence during accreditation reviews.

As a result, QA units frequently lack reliable, interpretable, and timely data on CLO attainment. This limitation constrains their ability to make evidence-based decisions regarding curriculum improvement, assessment redesign, and compliance with regulatory and accreditation requirements. These challenges suggest the need for more systematic and transparent approaches to CLO attainment analytics that go beyond reporting practices.

1.3. Overview of the EVALLOS framework and scope of this study

EVALLOS is an intelligent outcome-assessment platform previously introduced to support the measurement of Course Learning Outcomes (CLOs) and the aggregation toward Program Learning Outcomes (PLOs) using a structured data-processing pipeline and automated reporting. The platform operationalizes outcome-based assessment through (i) explicit mappings between assessment evidence and outcomes (e.g., item-to-CLO and CLO-to-PLO matrices), (ii) rule-based attainment computation from assessment data at the exam-team, class, and course levels, and (iii) standardized dashboards and report templates to enhance transparency and audit readiness. Building on that platform-level description, the present study focuses specifically on the design and empirical evaluation of the CLO attainment computation model and its traceability at item level in a Vietnamese university context. In particular, we validate the computed CLO attainment results against instructor-verified spreadsheet calculations across two consecutive semesters and examine the practical implications for quality assurance and accreditation preparation (Pham et al., 2025).

1.4. Research gaps

Existing studies and institutional practices have contributed valuable insights into the definition of learning outcomes, outcome-based curriculum design, and accreditation-oriented reporting. However, much of the current literature emphasizes outcome formulation or descriptive reporting, with limited empirical evidence on how CLO attainment can be computed in a transparent, auditable, and scalable manner within real institutional contexts.

In the Vietnamese higher education setting in particular, there is a lack of research that systematically examines how CLO attainment analytics can support QA processes across courses and programs, while remaining interpretable for instructors and verifiable for accreditation purposes. This gap highlights the need for research that not only proposes analytical frameworks for CLO assessment, but also evaluates their practical usefulness and reliability in supporting QA activities.

To address the above gap, this study aims to design and evaluate a structured approach to CLO attainment analytics that supports QA in Vietnamese higher education. The specific objectives of the study are to formalize the computation of CLO attainment, to examine its effectiveness in supporting reporting and decision-making, and to assess stakeholder perceptions of its usability and usefulness.

Accordingly, the study is guided by the following research questions:

RQ1: How is CLO attainment computed and validated using the EVALLOS-based computation workflow?

RQ2: Does the use of EVALLOS improve reporting efficiency and support evidence-based decision-making for QA stakeholders?

RQ3: How do instructors and QA staff perceive the usability and usefulness of EVALLOS for CLO assessment and reporting?

These research questions frame the study as an evaluation of CLO attainment analytics rather than a purely technical system description, and they align the investigation with broader educational QA objectives.

2. LITERATURE REVIEW

2.1. Outcome-based Education and constructive alignment

OBE is an educational paradigm that organizes curriculum design, teaching activities, and assessment practices around explicitly stated learning outcomes. Rather than emphasizing content coverage, OBE focuses on what learners are expected to demonstrate upon completion of a learning process (Spady, 1994). Within higher education, learning outcomes are typically articulated at multiple levels, including CLOs, Student Learning Outcomes (SLOs), and Program Learning Outcomes (PLOs), each serving a distinct but interconnected role in curriculum planning and evaluation.

CLOs describe the expected competencies students should achieve upon completing a specific course, while SLOs or PLOs represent broader competencies expected at the program level. Effective implementation of OBE requires coherence across these levels, ensuring that course-level outcomes meaningfully contribute to program-level goals (Harden, 2002). This coherence is most commonly operationalized through the principle of constructive alignment, which posits that learning activities and assessments must be systematically aligned with intended learning outcomes to support valid and meaningful evaluation of student achievement (Biggs & Tang, 2011).

Assessment plays a central role in this framework, providing the primary evidence for determining whether learning outcomes have been achieved. In an OBE context, assessment is not merely a grading mechanism but a critical component of QA, enabling institutions to monitor attainment of outcomes, evaluate curriculum effectiveness, and inform continuous improvement processes (Bloxham & Boyd, 2007). Consequently, the credibility of OBE implementation depends heavily on the transparency and validity of outcome-based assessment practices.

2.2. Models for Course Learning Outcome and Program Learning Outcome Attainment Measurement

The measurement of learning outcome attainment has been approached through both direct and indirect assessment models. Direct assessment relies on observable evidence of student performance, such as examination scores, assignments, projects, and rubric-based evaluations, which are explicitly mapped to learning outcomes. Indirect assessment, by contrast, gathers perceptions and reflections through surveys, interviews, alumni feedback, or employer evaluations (Allen, 2004).

Accreditation bodies and QA frameworks generally emphasize direct assessment as the primary source of evidence for outcome attainment, while recommending indirect methods as complementary inputs that provide contextual insights (ABET, 1932; AUN-QA, 2023). To operationalize direct assessment, institutions often employ threshold-based models, in which outcome attainment is determined by the proportion of students meeting predefined

performance criteria. Common thresholds include minimum passing percentages or rubric-level cutoffs, which may vary depending on institutional policy and disciplinary norms.

At the course level, CLO attainment is often determined using threshold-based models, in which a learning outcome is considered achieved when a predefined proportion of students meets or exceeds specified performance criteria. These thresholds may be defined using numerical cutoffs, rubric levels, or institutional benchmarks. At the program level, course-level results must be aggregated to infer the attainment of broader student or program learning outcomes. According to Harden (2002), aggregation rules should be explicitly defined, consistently applied, and transparent to stakeholders, as ambiguous or undocumented aggregation practices undermine the credibility of outcome assessment results.

Despite variations in institutional policy, the literature converges on the need for clear documentation of assessment logic, including how course-level evidence is combined, weighted, and interpreted at the program level. Transparent aggregation models are therefore essential for ensuring the validity, interpretability, and auditability of outcome attainment data used in QA processes.

2.3. Learning analytics for quality assurance

Learning analytics refers to the measurement, collection, analysis, and reporting of data about learners and their contexts to understand and optimize learning and the environments in which it occurs (Siemens & Long, 2011). In the context of QA, learning analytics provides a mechanism for transforming raw assessment data into actionable insights that support institutional decision-making.

Dashboards are a widely adopted analytical tool for presenting learning analytics results to stakeholders. Effective dashboards summarize complex data in accessible visual formats, enabling instructors, program coordinators, and QA units to monitor trends in outcome attainment, identify areas of concern, and evaluate the impact of curricular interventions (Verbert et al., 2013). However, visualization alone is insufficient for QA purposes if the underlying analytical logic is not transparent.

Two concepts frequently emphasized in the literature are traceability and interpretability. Traceability refers to the ability to follow assessment results back to specific learning outcomes, assessment items, and student evidence, which is essential for audit readiness and accreditation reviews. Interpretability concerns the extent to which stakeholders can understand how metrics are computed and what they signify in relation to educational decisions (Ferguson, 2012). Learning analytics systems that lack these properties risk being perceived as black boxes, limiting their acceptance and usefulness in QA contexts.

2.4. Limitations of existing approaches and systems

Although the existing literature provides a range of conceptual models and analytical tools for outcome assessment, several limitations persist in current practices. First, auditability remains a recurring concern. Many outcome assessment approaches do not explicitly document the computational logic linking assessment data to learning outcomes, making it difficult for external reviewers to verify results or reproduce calculations during accreditation audits.

Second, rubric-based assessment, which is widely recommended for evaluating higher-order cognitive skills, is often insufficiently integrated into outcome analytics models. While rubrics enhance assessment validity and reliability, their qualitative nature poses challenges for systematic aggregation unless explicitly modeled.

Third, cross-course aggregation of CLO data into program-level indicators is frequently underdeveloped. Existing studies often report outcome attainment at the course level without demonstrating how these results are consolidated across curricula to support program-level QA. As a result, institutions may possess fragmented outcome data that are inadequate for strategic decision-making or continuous improvement planning.

These limitations suggest a need for more coherent, transparent frameworks that integrate assessment design, outcome computation, and analytics in ways that are both educationally meaningful and operationally feasible.

2.5. Design requirements derived from the literature

Synthesizing the reviewed literature reveals several design requirements for an effective CLO attainment analytics framework that supports QA:

● Requirement 1 (R1): Transparent computation of CLO attainment. The logic and formulas used to compute outcome attainment should be explicit, interpretable, and verifiable by QA stakeholders.

● Requirement 2 (R2): Integration of rubric-based assessment. The framework should support both quantitative scores and rubric-based evaluations to capture a broader range of learning outcomes, including higher-order cognitive skills.

● Requirement 3 (R3): Traceability for QA and accreditation. Outcome analytics should allow stakeholders to trace results back to assessment items and evidence, ensuring audit readiness and accountability.

● Requirement 4 (R4): Usability for instructors and QA staff. The system should present outcome data in a manner that is understandable and actionable for non-technical users, facilitating adoption and effective use in practice.

These requirements provide the conceptual foundation for the design and evaluation of EVALLOS, positioning it as a response to identified gaps in outcome-based assessment and QA literature rather than as a feature-based learning management system.

3. MATERIALS AND METHODS

3.1. Research design

This study adopts a Design science research approach, combined with a case study, to design, implement, and evaluate a framework for assessing CLOs that supports QA in higher education.

Design Science Research is appropriate for this study because its primary objective is to create and evaluate an artifact that addresses a clearly identified educational problem: the lack of transparent, auditable CLO attainment analytics for QA. According to Hevner et al. (2004), design science research emphasizes the development of artifacts such as models, methods, or systems and requires systematic evaluation of their utility, validity, and effectiveness in a real-world context. In educational research, design science research has been widely applied to learning analytics and assessment systems where practical relevance and empirical evaluation are equally important (Gregor & Hevner, 2013).

To complement the design-oriented perspective, a case study strategy is employed to examine the application of the proposed CLO analytics framework within an authentic institutional setting. Case studies enable in-depth investigation of educational interventions within their real context, particularly when the boundaries between the intervention and the environment are not clearly separable. By integrating design science research with a case study, this research not only proposes a structured approach to CLO attainment computation but also evaluates its practical usefulness for instructors and QA stakeholders.

3.2. Study context

The study was conducted at a public university in Vietnam that implements OBE and is subject to national QA regulations and internal review processes. The case study focused on undergraduate programs within one academic faculty, where CLO-based assessment is formally required for curriculum monitoring and accreditation preparation.

The empirical setting involved:

● Programs: undergraduate programs within a single faculty

● Courses: multiple core and specialized courses offered during the study period

● Class sections: several parallel classes across different semesters

● Exam teams: for each course, assessment activities were organized into exam teams (e.g., midterm examinations, final examinations, and project-based assessments), each representing a distinct assessment instance linked to specific CLOs

● Students: undergraduate students enrolled in the selected courses and participating in the defined exam teams

● Implementation period: two consecutive academic semesters

In this study, an exam team refers to a cohort-level assessment unit in which a group of students completes the same assessment under the same structure, marking scheme, and CLO mapping. Exam teams served as the primary

unit for collecting assessment data and computing CLO attainment, thereby enabling consistent analysis across classes, courses, and semesters.

This context was selected because it reflects typical conditions under which Vietnamese universities conduct CLO assessment, including large class sizes, diverse assessment formats, multiple exam teams per course, and institutional demands for consistent and auditable outcome reporting to support QA and accreditation activities.

3.3. Data sources

Multiple data sources were collected to support both the computation of CLO attainment and the evaluation of the proposed framework.

First, item-level student assessment data were collected from course examinations and assignments organized through exam teams. For each assessment item (e.g., individual exam questions, quiz items, or project components), the dataset included each student's score, the maximum possible score, and the instructor-defined passing criterion. This item-level granularity enabled tracing student performance directly to specific assessment components rather than aggregated course grades. Assessment items covered a range of formats, including written examination questions, quizzes, and project-based tasks.

Second, rubric-based evaluation data were collected for assessment items designed to measure higher-order cognitive skills such as analysis, problem-solving, and communication. For these items, student performance was evaluated using predefined rubric levels (e.g., inadequate, adequate, good, excellent), each corresponding to a specific performance range. Rubric scores were recorded at the level of individual assessment items, enabling integration of qualitative judgments into the CLO attainment computation, consistent with recommendations for rubric-based assessment in higher education (Brookhart, 2013).

Third, CLO mapping data were obtained from course syllabi and instructor-defined mappings between individual assessment items and CLOs. Each assessment item was linked to one or more CLOs based on its intended learning objective, ensuring traceability between item-level student performance and outcome attainment.

Finally, qualitative data were collected through semi-structured interviews and short surveys with instructors and QA staff. These data focused on perceptions of transparency, usability, and usefulness of CLO attainment reports derived from item-level assessment data for teaching improvement and QA activities.

3.4. Procedure

The research procedure consisted of four main stages, designed to ensure systematic collection, computation, and interpretation of CLO attainment data in support of QA activities.

Stage 1: Definition and validation of CLOs

For each selected course, CLOs were reviewed and validated by the course instructors prior to data collection. CLOs were defined in alignment with program-level learning objectives and OBE principles, ensuring that each CLO represented a measurable statement of expected student knowledge, skills, or competencies.

To enhance clarity and measurability, CLO statements were formulated using observable action verbs and explicitly linked to assessment evidence. This validation step ensured that CLOs could be meaningfully assessed through course-level evaluation activities and that their attainment could be consistently interpreted by instructors and QA staff.

Stage 2: Mapping assessment items to CLOs

All assessment activities within each course were organized into exam teams, where an exam team represents a cohort-level assessment unit in which students complete the same assessment under an identical structure, marking scheme, and CLO mapping. Typical exam teams included midterm and final examinations, as well as project-based assessments.

Within each exam team, assessment activities were decomposed into individual assessment items, such as examination questions, quiz items, or project components. Each assessment item was then mapped to one or more CLOs based on its intended learning objective.

The mapping was represented as a binary matrix, where 1 indicated that an assessment item contributed to the measurement of a given CLO, and 0 indicated no contribution. This item-to-CLO mapping established explicit

traceability between student performance data and intended learning outcomes, forming the analytical foundation for CLO attainment computation.

Stage 3: Data collection and CLO attainment computation

Student performance data were collected at the **item level** for each exam team. For every assessment item, the dataset included the score obtained by each student or the rubric level assigned, the maximum possible score (where applicable), and the predefined passing criterion specified by the instructor.

Let $Q_c = \{q_1, q_2, \dots, q_k\}$ denote the set of assessment items mapped to a given CLO c. For each assessment item $q_i \in Q_c$, a student was considered to have passed the item if one of the following conditions was satisfied:

- for score-based items, the obtained score was equal to or greater than the predefined passing threshold (e.g., 50% of the maximum score);
- for rubric-based items, the achieved rubric level met or exceeded the institutional minimum standard (e.g., "adequate" or higher).

For each CLO c, the number of students who achieved the CLO within a given exam team $t$was determined by aggregating item-level results across all assessment items mapped to that CLO. A student was considered to have achieved CLO $c$if they met the passing criterion for at least one assessment item linked to that CLO, in accordance with institutional assessment policy.

CLO attainment for exam team $t$was computed as:

$$A_{c,t} = \frac{N_{pass,c,t}}{N_{total,t}} \times 100\%$$

where $N_{pass,c,t}$represents the number of students in exam team, t: who achieved CLO c, and $N_{total,t}$denotes the total number of students participating in that exam team.

When a course included multiple exam teams, course-level CLO attainment was calculated by aggregating CLO attainment values across exam teams, weighted by the number of participating students:

$$A_c^{course} = \frac{\sum_{t=1}^{T} N_{total,t} \cdot A_{c,t}}{\sum_{t=1}^{T} N_{total,t}}$$

This weighted aggregation ensured that exam teams with larger student cohorts contributed proportionally to course-level CLO attainment results.

Stage 4: Analysis and reporting

Computed CLO attainment results were summarized at the exam team, class, and course levels. Results were presented using tabular summaries and descriptive visualizations to support interpretation by instructors and QA stakeholders.

At the instructional level, CLO attainment results enabled instructors to identify learning outcomes with lower attainment and to reflect on potential adjustments to teaching strategies, assessment design, or learning activities. At the QA level, aggregated CLO reports provided structured and auditable evidence for curriculum monitoring, internal review, and accreditation preparation.

The outputs generated during this stage served as the empirical basis for subsequent evaluation activities, including validation against manual computation, assessment of reporting efficiency, and analysis of user perceptions regarding transparency and usefulness.

3.5. Evaluation instruments

The proposed CLO attainment analytics framework was evaluated using three complementary instruments.

First, validation against manual computation was conducted by comparing CLO attainment results generated by the framework with results calculated manually by instructors using spreadsheets. Differences were analyzed to assess computational accuracy and consistency.

Second, processing efficiency was evaluated by measuring the time required to generate CLO reports using manual procedures versus the proposed framework. This comparison provided evidence of potential efficiency gains for instructors and QA units.

Third, usability and perceived usefulness were assessed through surveys and interviews with instructors and QA staff. Survey items focused on clarity of reports, ease of use, and perceived value for teaching improvement and QA decision-making, consistent with established usability evaluation practices in educational technology research.

4. RESULTS AND DISCUSSION

4.1. Results

4.1.1. Validation of Course Learning Outcome attainment computation

This section reports the results of validating the CLO attainment computation model described in Section 3.4. To examine computational accuracy, CLO attainment values generated by the proposed framework were compared with results calculated manually by course instructors using spreadsheet-based procedures.

Across the analyzed courses and exam teams, the framework's CLO attainment percentages were highly consistent with manual calculations. For all evaluated CLOs, the attainment values were identical or differed only marginally due to rounding conventions. No systematic discrepancies were observed between automated and manual results.

These findings indicate that the item-level, threshold-based computation model reliably reproduces instructor-validated CLO attainment outcomes while ensuring consistent application of assessment rules across exam teams and courses. The explicit mapping between assessment items and CLOs also enabled clear traceability from aggregated CLO attainment values back to individual assessment evidence, supporting auditability for QA purposes.

Table 1. Comparison between manual and computed CLO attainment results

Course	Exam team	CLO	Manual calculation (%)	Computed result (%)
Advanced Computer Graphics	Midterm	CLO1	69.23%	69.24%
Advanced Computer Graphics	Midterm	CLO2	53.85%	53.85%
Advanced Computer Graphics	Midterm	CLO3	46.15%	46.15%
Advanced Computer Graphics	Final	CLO1	92.31%	92.31%
Advanced Computer Graphics	Final	CLO2	69.23%	69.24%
Advanced Computer Graphics	Final	CLO3	69.23%	69.24%

4.1.2. Reporting efficiency and workload reduction

To evaluate the impact of the proposed framework on reporting efficiency, the time required to generate CLO attainment reports was examined for both manual and system-supported procedures.

Under the manual approach, instructors typically aggregated item-level scores, determined each assessment item's passing status, and summarized CLO attainment in spreadsheets. This process required substantial effort, particularly for courses with multiple exam teams and large student cohorts. In contrast, once assessment data and item-to-CLO mappings were defined, the proposed framework automatically generated CLO attainment reports.

The results show a substantial reduction in reporting workload. CLO attainment reports that previously required several hours of manual processing could be generated within minutes using the proposed approach. This improvement was consistently observed across courses and semesters, regardless of assessment format.

From a QA perspective, the reduced reporting time enabled QA staff to focus more on interpreting CLO attainment trends and discussing improvement actions rather than on data compilation. These findings suggest that structured CLO attainment analytics can enhance the efficiency of outcome-based QA processes.

4.1.3. Perceived usefulness for instructors and quality assurance staff

Perceptions of the proposed CLO attainment analytics framework were collected through semi-structured interviews with instructors and QA staff who reviewed CLO attainment reports derived from item-level assessment data.

Overall, interview feedback suggested that the participants considered the CLO attainment reports useful for both instructional reflection and QA review. The instructors reported that the explicit linkage between assessment items and CLOs improved the interpretability of attainment results compared with prior spreadsheet-based reporting practices. Several instructors noted that exam team-level summaries helped them identify which assessments were most strongly associated with lower CLO attainment, supporting discussions about potential revisions to assessment design and teaching activities.

The QA staff emphasized the value of traceability and consistency in CLO reporting. The participants highlighted that clearly defined computation rules and standardized report structures made it easier to verify evidence of outcome attainment during internal review. The QA staff also reported that the availability of comparable CLO indicators across courses and semesters supported more systematic monitoring of curriculum quality.

Because these findings were derived from qualitative interviews rather than a standardized questionnaire, they should be interpreted as exploratory evidence of perceived usefulness. Future work should incorporate validated usability instruments and larger samples to quantify user satisfaction and adoption factors.

Table 2. Summary of interview themes reported by instructors and QA staff

Theme	Description	Reported by
Interpretability	Easier to understand CLO attainment due to explicit item-to-CLO linkage	Instructors, QA staff
Traceability	Easier to trace results back to assessment evidence for review/audit	QA staff
Consistency	More consistent CLO reporting across exam teams and courses	QA staff
Instructional reflection	Helps identify outcomes needing instructional or assessment revision	Instructors

4.1.4. Summary of results

In summary, the results demonstrate that the proposed CLO attainment analytics framework produces accurate, verifiable CLO attainment values, significantly reduces reporting workload, and is well-received by instructors and QA staff. These findings provide empirical support for the use of structured, item-level CLO analytics as a foundation for outcome-based QA in Vietnamese higher education.

4.2. Discussion

This study sets out to design and evaluate a structured model for computing CLO attainment that supports outcome-based QA in Vietnamese higher education. The discussion below interprets the findings in relation to the research questions and situates them within the broader literature on OBE and learning analytics.

First, regarding RQ1, the results demonstrate that the proposed item-level, threshold-based computation model produces CLO attainment values that are consistent with instructor-validated manual calculations. This finding aligns with prior studies emphasizing the importance of explicit assessment logic and transparent aggregation rules in outcome-based assessment (Allen, 2004; Suskie, 2008). By tracing student performance from individual assessment items to CLO attainment, the model addresses a common concern in QA practice, namely, the difficulty of verifying how outcome indicators are derived from raw assessment data. The observed consistency between manual and computed results suggests that formalizing CLO computation does not alter instructional judgment, but rather standardizes and documents it in a reproducible manner.

Second, regarding RQ2, the findings indicate that structured CLO attainment analytics can substantially reduce the reporting workload for instructors and QA staff. Previous research has noted that outcome-based assessment often places a significant administrative burden on faculty, particularly when reporting relies on ad hoc spreadsheet calculations (Suskie, 2008). The reduction in processing time observed in this study suggests that analytics-supported reporting can shift stakeholder effort away from data preparation toward interpretation and decision-making. From a QA perspective, this shift is particularly important, as it enables more timely discussions of curriculum improvement and supports evidence-based monitoring across courses and semesters.

Third, with respect to RQ3, qualitative feedback from instructors and QA staff indicates that the proposed approach is perceived as useful for both instructional reflection and QA review. The participants highlighted the value of explicit item-to-CLO linkage and consistent reporting structures, which improved the interpretability and traceability of evidence of outcome attainment. These perceptions echo findings in the learning analytics literature, which emphasize that transparency and interpretability are critical for stakeholder acceptance of analytic tools in educational contexts (Verbert et al., 2013). Although the present study relied on qualitative interviews rather than standardized usability instruments, the reported themes suggest that structured CLO analytics can enhance stakeholder confidence in outcome-based assessment practices.

Taken together, the findings contribute to the literature by providing empirical evidence that CLO attainment analytics can be operationalized in a manner that is transparent, auditable, and practically useful within a real institutional context. Rather than proposing new learning outcomes or assessment policies, this study demonstrates how existing OBE principles can be translated into consistent analytical procedures that support QA requirements in Vietnamese higher education.

Several limitations should be acknowledged. First, the study was conducted within a single faculty at one university, which may limit the generalizability of the findings to other institutional contexts or disciplines. Second, the evaluation of usability and perceived usefulness relied on qualitative interviews with a limited number of participants. Future research should incorporate validated survey instruments and larger samples to quantitatively assess user satisfaction and adoption. Finally, the study focused primarily on CLO attainment at the course level; aggregating to program-level outcomes and integrating indirect assessment data were beyond the scope of the present analysis.

5. CONCLUSION

This study presents and evaluates a structured model for computing CLO attainment based on item-level assessment data and explicit mapping rules. Using a design science and case study approach, the research demonstrates that the proposed method produces accurate and verifiable CLO attainment results, reduces reporting workload, and is perceived as useful by instructors and QA staff.

The findings underscore the importance of transparent and auditable CLO analytics as a foundation for outcome-based QA. In the context of Vietnamese higher education, where institutions face increasing regulatory and accreditation pressures, such approaches can support more consistent monitoring of learning outcomes and facilitate evidence-based curriculum improvement.

Future research should extend this work by examining the aggregation of CLO attainment to program-level outcomes, incorporating indirect assessment measures, and evaluating long-term impacts on curriculum design and teaching practices across multiple institutions. By advancing systematic and interpretable outcome analytics, higher education institutions can strengthen both the credibility and effectiveness of OBE and QA.

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