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ASSESSMENT OF THE CONFORMITY OF THE CONTENT OF HIGHER EDUCATION TO THE COMPETENCIES OF FUTURE SPECIALISTS

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ARTICLE INFO	ABSTRACT
Article history: Received:2025-11-19 Received in revised form:2025-12-05 Accepted:2025-12-27 Available online: 2026-06-23 Keywords: competency-based education, higher education, evaluating competencies, quality assurance, data analysis. 2010 Mathematics Subject Classifications: 60K25, 68M20, 90B05.	This study examines how higher education systems adapt to the growing importance of competency-based education in response to rapidly evolving professional and societal demands. In the context of accelerating digitalization and globalization, traditional skill sets are increasingly insufficient, while transversal competencies such as problem-solving, creativity, digital literacy, and collaboration have become essential for graduate employability. The research investigates the degree to which university curricula align with these emerging competency requirements. Curriculum–competency alignment is evaluated through three complementary analyses. First, curricular syllabi are examined to determine how individual subjects contribute to targeted competencies and how learning outcomes, activities, and assessments reflect competency-based approaches. Second, chapter-level analysis explores whether competency development is consistently distributed across course content or concentrated in specific topics. Third, employer survey data capture industry perceptions regarding the importance of competencies and the level of satisfaction with graduates’ preparedness. A structured scoring framework integrates subject-level alignment, chapter-level contribution patterns, and employer evaluations to identify competency gaps, curriculum weaknesses, and mismatches between educational intentions and industry expectations. The findings provide actionable insights for curriculum redesign, quality assurance, and the continuous improvement of competency-oriented higher education.

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1 INTRODUCTION

In today’s rapidly transforming world, the role of higher education extends beyond imparting disciplinary knowledge; it also involves equipping graduates with competencies that align with evolving labor-market needs. Competencies—commonly understood as a combination of knowledge, skills, and attitudes required for effective performance—have become central to modern educational frameworks. They help ensure that graduates not only achieve academic success but also meet employer expectations in increasingly complex and dynamic professional environments.

The design of academic programs plays a pivotal role in fostering these competencies. Subject syllabuses and their internal structure (including the content and sequencing of chapters/modules) provide a practical foundation for implementing competency-based education in universities [6][7]. From theoretical concepts to applied tasks and assessment activities, each element of the curriculum represents an opportunity to develop essential capabilities such as problem-solving, teamwork, adaptability, and digital literacy. These competencies—often described as “21st-century competencies”—are widely regarded as critical for graduates navigating the digital economy and globalized labor markets [1].

Despite ongoing curriculum reforms, a noticeable gap often persists between competencies developed through higher education and those demanded by employers. Contemporary industries prioritize graduates who demonstrate not only technical expertise but also the ability to innovate, collaborate effectively, and adapt to changing tools, processes, and organizational contexts. This misalignment has increased interest in more systematic methods for evaluating how well educational content conforms to competency requirements and in strengthening the alignment between higher education standards and workforce needs [2].

This article examines the relationship between competencies and curriculum content by focusing on how subject syllabuses and chapter-level coverage contribute to developing employable graduates. By combining curriculum evidence with stakeholder expectations, the study aims to support quality assurance and curriculum improvement efforts, helping higher education institutions enhance graduate readiness for professional success and lifelong learning.

2 METHODS

2.1 Research Approach

This study adopts a mixed-methods approach to evaluate the quality of higher education based on the alignment of competencies within subject syllabuses, chapters, and employer demands [3]. The research focuses on three primary factors:

Alignment of Subjects with Competencies:

Let $S = \{ S_1, S_2, \dots, S_m \}$ represent the set of all subjects included in the study, where each S_i corresponds to a specific subject in the curriculum. The study evaluates the alignment of these subjects with the competencies established by the government, represented as $C = \{ C_1, C_2, \dots, C_n \}$, where each C_j denotes a distinct competency.

Contribution of Chapters to Competencies:

Each subject S_i comprises a set of chapters $Ch_i = \{ Ch_{i1}, Ch_{i2}, \dots, Ch_{i3} \}$, where Ch_{ij} represents the j -th chapter of the i -th subject. The study examines how individual chapters within each subject contribute to the development of the competencies in C .

Employer Demands for Competencies:

The competencies demanded by employers are represented as $E = \{ E_1, E_2, \dots, E_p \}$, where each E_k corresponds to a competency deemed essential by employers for graduates in specific specialties. The study assesses the alignment between these employer-demanded competencies and the outcomes produced by higher education institutions.

This structured approach provides a comprehensive framework for measuring the quality of higher education by analyzing the relationships between the curriculum, competencies, and workforce demands [4].

2.2 Competency Alignment Measurement (CAS) for Subjects

To measure how well each subject in a given program aligns with the competencies established by the government, a Competency Alignment Score (CAS) is calculated. For each subject S_i , the score is determined using the following formula:

$$CAS_i = \frac{(\sum_{j=1}^n \omega_j \cdot C_{ij})}{(\sum_{j=1}^n \omega_j)} \quad (1)$$

Where:

- C_{ij} represents the contribution of subject S_i to the j -th competency, rated on a scale of 0 to 1 (or 0 to 100).
- ω_j is the weight assigned to each competency based on its importance in the government's competency framework.
- n is the total number of competencies assessed for each subject.

This score reflects the degree of alignment between the subject content and the required competencies.

2.3 Chapter-Level Competency Contribution (CCC)

To assess the contribution of individual chapters within each subject, a CCC score is calculated. For each chapter Ch_{ik} within subject S_i , the score is determined using the following formula:

$$CCC_{ik} = \frac{(\sum_{j=1}^n \omega_j \cdot ChC_{ijk})}{(\sum_{j=1}^n \omega_j)} \quad (2)$$

Where:

- ChC_{ijk} represents the contribution of chapter k in subject S_i to competency j .
- ω_j is the weight of competency j , based on its significance.
- n is the total number of competencies evaluated.

The overall subject alignment is refined by aggregating the chapter-level contributions:

$$CAS_i = \frac{(\sum_{k=1}^m CCC_{ik} \cdot \vartheta_k)}{(\sum_{k=1}^m \vartheta_k)} \quad (3)$$

Where ϑ_k represents the weight of chapter k in subject S_i .

2.4 Employer Competency Satisfaction Index (ECSI)

To measure how well higher education institutions are meeting the competency expectations of employers, an ECSI is computed. This index is based on survey data from employers regarding the competencies they deem essential for graduates. The index for each competency j is calculated as:

$$ECSI_j = \frac{(\sum_{l=1}^p E_{jl})}{p} \quad (4)$$

Where:

- E_{jl} is the rating provided by employer l for competency j (scored on a scale of 0–1 or 0–100).
- p is the total number of employers surveyed.

The overall employer satisfaction with the competencies provided by higher education institutions is calculated by aggregating the individual competency satisfaction scores:

$$ECSI = \frac{(\sum_{j=1}^n \omega_j \cdot ECSI_j)}{\sum_{j=1}^n \omega_j} \quad (5)$$

Where ω_j represents the weight of each competency based on its importance in the professional domain.

2.5 Overall Quality Index (OQI)

The final measure of the quality of higher education is represented by the OQI, which integrates the results from the CAS, CCC and ECSI. The OQI is calculated as:

$$OQI = \alpha \cdot CAS + \beta \cdot CCC + \gamma \cdot ECSI \quad (6)$$

Where:

- α, β, γ are weights assigned to each factor based on its perceived importance in evaluating the quality of higher education.
- CAS represents the average competency alignment score for subjects.
- CCC represents the average chapter contribution score for subjects.
- ECSI is the employer competency satisfaction index.

3 DATA COLLECTION

The study examines this reflection based on three complementary data sources and considers how higher education curricula reflect (i) government-defined competency requirements and (ii) labor-market expectations. Data collection was made to facilitate the computation of the proposed indices: Competency Alignment Score (CAS), Chapter-Level Competency Contribution (CCC), Employer Competency Satisfaction Index (ECSI), and the integrated Overall Quality Index (OQI), by ensuring that inputs from different sources are comparable and traceable to the same competency set $C=\{C_1, \dots, C_n\}$.

3.1 Subject syllabises

From the official institutional curriculum of the chosen program(s) we collected the subject syllabuses. For that reason, each syllabus was treated as a primary evidence document outlining intended learning outcomes, topical coverage, learning activities, and assessment mechanisms. The following elements were extracted for each subject S_i :

- Course title, credit/workload information, and prerequisites (if any).
- intended learning outcomes and course objectives.
- topic plan (chapters, weeks, or modules).
- teaching/learning activities (lectures, labs, projects, independent work).
- assessment structure (exams, quizzes, labs, projects, presentations).

The syllabus content was linked to the government competency framework C to operationalize subject–competency alignment. Using a standardized coding rubric, C_{ij} (the contribution of subject S_i to competency C_j) was evaluated on a five-level scale normalized to $[0,1]$:

Table 1. Coding rubric for subject–competency and chapter–competency scoring (normalized to $[0,1]$)

Score	Label	Decision rule (what counts as evidence)	Typical syllabus indicators
0.00	No evidence	Competency not mentioned and no clear related activity/assessment	No relevant learning outcome, topic, or task
0.25	Implicit/ minor	Competency may be indirectly supported but not targeted	Topic coverage without practice or assessment
0.50	Moderate	Competency appears in topics and is partially supported by activities or assessment	One lab, small assignment, limited assessment weight
0.75	Strong	Competency is clearly supported by activities and assessed	Multiple tasks + explicit learning outcome + graded component
1.00	Explicit/ primary focus	Competency is an explicit course goal and strongly assessed	Dedicated outcomes + major project/exam component aligned

Coding was done on two levels:

1. Subject-level coding (for CAS): based on learning outcomes, targets, and assessment artifacts as the principal indicators of competency coverage.
2. Chapter-level coding (for CCC): using the topic plan to assess the contribution of each chapter/module Ch_{ik} to each competency C_j , producing ChC_{ijk} values.

Where syllabuses varied in arrangement (e.g., weekly plans vs. chapter plans), the topic units were grouped into homogeneous “chapters/modules” to allow consistent scoring for chapter-level coding. The produced syllabus coding data generated the necessary inputs for formulas (1) – (3). Student surveys

3.2 Employer surveys

Employer expectations were collected through a structured survey distributed to organizations operating in sectors relevant to the analyzed specialty domain(s). The survey captured two types of information aligned with the competency set C :

- Competency importance: how critical each competency C_j is for graduate employability and early-career performance;
- Competency satisfaction/readiness: the extent to which employers observe adequate competency levels among graduates.

Items were measured using Likert-type response scales and included an optional open-ended section allowing employers to identify emerging competencies or missing curriculum components. To support $ECSI$ calculation, all employer ratings were transformed to a common $[0,1]$ range and aggregated across respondents for each competency C_j , producing $ECSI_j$ values used in formulas (4) – (5).

Table 3. Employer survey questionnaire items aligned with competencies C_j (inputs for $ECSI$)

Variable	Item (what employer answers)	Competency link	Scale	Used in formula
Imp_{ji}	“How important is competency (C_j) for entry-level graduates in your organization?”	(C_j)	Likert (e.g., 1–5) → normalized $([0,1])$	(optional) weight setting / priority analysis $ECSI_j = \frac{1}{p} \sum_{i=1}^p E_{ji}$
E_{ji}	“How satisfied are you with graduates’ level in competency (C_j)?”	(C_j)	Likert (e.g., 1–5) → normalized $([0,1])$	
—	“Which competencies are most missing in graduates?” (optional)	Any	Open-ended	Explains gaps in Discussion
—	“Which curriculum topics should be strengthened?” (optional)	Any	Open-ended	Actionable recommendations

3.3 Student surveys

Student perceptions were obtained using a brief, structured questionnaire aligned with the same competency framework C . The student survey was also intended to triangulate curriculum intent (syllabuses) with learner experience by measuring:

- self-assessed development of competencies during the program.
- perceived relevance of subject content to professional tasks.
- perceived gaps between taught content and workplace expectations.

Responses were obtained with Likert-type responses and normalized to $[0,1]$. Student data were not used to replace employer or syllabus evidence but were considered as a supporting layer in the interpretation of alignment patterns and gap explanations found in Results and Discussion.

Table 3. Student survey items aligned with competencies C_j

Variable	Item (what student answers)	Competency link	How you use it
SD_{sj}	"My program helped me develop competency C_j ."	C_j	Supports interpretation of CAS/CCC vs ECSI gaps
Rel_s	"Course content is relevant to real professional tasks."	General	Explains employability alignment
Gap_s	"I feel there are missing skills/topics needed for work."	General	Explain gap reasons
—	"Which skills/topics should be taught more?" (optional)	Any	Qualitative themes in Discussion

3.4 Data preprocessing and harmonization

Since the study includes syllabus coding and survey-based ratings, all inputs were reconciled to a common measurement range, to allow for comparability across indices:

- Normalization: values from rubric scoring and survey scales were transformed to [0,1] (e.g., direct scaling or min–max transformation depending on the original scale format).
- Aggregation rules: subject-level competency values C_{ij} were computed from syllabus evidence, while chapter-level contributions ChC_{ijk} were computed based on chapter/topic evidence. Employer ratings were averaged to produce $ECSI_j$ per competency, then aggregated using weights ω_j .
- Managing missing data: incomplete survey responses were excluded from competency-level aggregation when they prevented reliable computation of competency scores; otherwise, competency scores were calculated from available items within a respondent record.

Using equations (1) – (6), this preprocessing yielded a uniform dataset enabling calculation of CAS, CCC, ECSI, and OQI.

4 DATA ANALYSIS

Quantitative index calculations were supplemented with interpretive triangulation among the three evidence sources (syllabuses, employers, students) in data analysis. The analysis took place in four steps.

- *Step 1: Calculating subject-level alignment (CAS).* For each subject S_i , a Competency Alignment Score was computed using formula (1) by combining competency contributions C_{ij} and competency weights ω_j . To this end, the subject-level alignment profile was created and enabled recognition of subjects that cover essential competencies strongly or very weakly.
- *Step 2: Building chapter-level contribution (CCC).* The contribution values at chapter level to competency ChC_{ijk} were computed using formula (2). These chapter-level scores were then merged in formula (3) for subject refinement and included chapter weights ϑ_k . This step makes the "granular diagnosis" feasible by letting us know which chapters/modules are driving the competency development and which chapters weren't contributing enough.
- *Step 3: ECSI (employer satisfaction).* Aggregated ratings from employers were used to calculate competency-level satisfaction $ECSI_j$ based on formula (4) and the general ECSI score based on formula (5), with corresponding competency-level weights called ω_j . This results in an external validity view of whether the graduates' skills correspond to market requirements.

- *Step 4: Incorporate indices to overall quality (OQI) and analyze gaps.* The Overall Quality Index is calculated using formula (6):

$$OQI = \alpha \cdot CAS + \beta \cdot CCC + \gamma \cdot ECSI$$

where α , β , γ indicate the relative importance given to (i) subject alignment, (ii) chapter contribution, and (iii) employer satisfaction.

Competency profiles from syllabus coding (CAS/CCC elements) were analyzed to identify trends in misalignment and were examined at the level of the employers' expectations (ECSI component). Student survey patterns were instrumental for interpretation when employers reported shortages of specific competencies and when students had no practical exposure. The resulting analysis results in actionable suggestions for curriculum optimization that show, based on student needs, what skills should be broadened, and at what level (subject versus chapter-level) [5].

5 RESULT AND DISCUSSION

5.1 Descriptive outcomes of the proposed indices

The proposed evaluation framework produced four complementary outputs: (i) subject-level competency alignment (CAS), (ii) chapter-level competency contribution (CCC), (iii) employer competency satisfaction (ECSI), and (iv) an integrated quality indicator (OQI). Together, these measures provide a multi-perspective view of curriculum–competency conformity by combining internal curriculum evidence (syllabuses and chapter structures) with external stakeholder expectations (employers) and supportive learner perception data (students).

At the subject level, CAS values enable comparison across subjects and identification of courses that strongly contribute to the targeted competency set versus those that provide limited or indirect contributions. The CCC results refine this picture by revealing intra-subject variability: some subjects demonstrate uneven competency development where particular chapters contribute substantially while other chapters provide minimal coverage. This chapter-level visibility is a key advantage of the proposed approach because it allows curriculum improvement efforts to focus not only on “which course” but also “which part of the course” requires enhancement.

5.2 Competency coverage patterns in syllabuses (CAS and CCC)

Across analyzed syllabuses, the method suggests that coverage is typically more explicit when competencies are directly reflected in learning outcomes and assessment tasks. On the other hand, competencies may be expressed indirectly (indicative of topic coverage), but may be neither consistently nor systematically applied, leading to lower rubric scores and weak alignment in CAS/CCC outputs. This distinction matters in that curriculum documents can introduce related topics but without assessment or learning outcomes being explicitly directed to competencies, students might not reliably develop the intended skill set.

CCC also assists in the identification of “structural gaps,” whereby competency development is localized in a small number of chapters rather than occurring across the whole subject. This kind of concentration may reflect fragile competency formation: if students miss or underperform in those chapters, the competency outcome is disproportionately affected. Curriculum redesign could help address this limitation by redistributing competency-related tasks over several weeks/modules and aligning assessment accordingly.

5.3 Employer expectations and alignment gaps (ECSI interpretation)

Employers' survey scores reflect competency preferences and graduate readiness, while *ECSI* scores reflect the labor-market view of competency sufficiency. A comparison between syllabus-based alignment (called *CAS/CCC* profiles) and employer satisfaction (*ECSI*) assists in identifying misalignment in a structured manner. It is because of this comparison that competency gap diagnosis can be done on both sides in practice:

- *Under-supplied competencies*: competencies recognized as significant by employers but inadequately reflected in syllabuses (low *CAS/CCC* relative to *ECSI*). These highlight areas of improvement on the curriculum (e.g., integrating greater practice-related work, applied projects, or tool-based education).
- *Over-emphasized competencies*: competencies with a high density represented in syllabuses, but ones whose values do not appear to be high on employer lists. These do not necessarily need to be eliminated but are data-driven to optimize workload and rebalance to increase relevancy to employability.

In addition, employer-provided open-ended responses (where captured) can uncover emergent or quickly changing expectations that have not been codified in the frameworks of the government yet. This is particularly pertinent in an era of digital transformation where requirements for skills develop faster than standards and curriculum refreshes.

5.4 Integrated evaluation using OQI and implications for quality assurance

The OQI incorporates both internal curriculum conformity (*CAS/CCC*) and external stakeholder satisfaction (*ECSI*) into a single quality-oriented measure. Conceptually, it helps with quality assurance in two ways. First, it offers an interpretable summary indicator suitable for program-level monitoring and benchmarking across departments or years. Second, since OQI is decomposable into its components, diagnostic usefulness remains stakeholders can follow if poor overall quality is due to weak subject alignment, uneven chapter-level contribution, or mismatched employer expectations.

From a policy and management point of view, the methodology can provide a framework to evidence-based curriculum improvement and link revisions to measurable outcomes. For instance, program committees may focus on (i) revising subjects with systematically low *CAS*, (ii) restructuring chapters with weak *CCC* contributions, and (iii) addressing employer-prioritized competencies with low *ECSI*. Crucially, the approach promotes a focus on continual quality improvement rather than a one-time curriculum audit.

5.5 Integrated evaluation using OQI and implications for quality assurance

In contrast to purely qualitative curriculum reviews, the proposed approach adds a transparent and replicable quantitative dimension that is rooted in educational documentation and stakeholder evidence. Whereas course-level mapping has been the focus for approaches to *CCC* analysis, the chapter-level *CCC* analysis delivers fine-grained information that is directly usable by the teacher. Furthermore, through *ECSI* the evaluation extends beyond internal academic criteria and explicitly addresses employability implications—which have become increasingly important to the quality of higher education.

Similarly, this method relies on sufficient syllabus documentation and clarity of learning outcomes. In other words, if the syllabuses do not accurately reflect current teaching and assessment practices, the method may underestimate the truth behind real competency development. Another point in note can be limited at least in terms of future work to add more tentative evidence sources (e.g., assessment artefacts, student work samples, or learning analytics) while maintaining the interpretability of *CAS/CCC/ECSI/OQI*.

6 Conclusion

The study offered a systematic approach to an evaluation of whether higher education curriculum content aligned with competency needs by integrating evidence from its syllabus with employers' and students' perspectives. The framework proposes measurable indices—CAS for subject-level alignment, CCC for chapter-level contribution, *ECSI* for employer satisfaction, OQI as an integrated quality indicator—and it supports both diagnostic evaluation and program-level monitoring. Integrating several data sources into one evaluation pipeline improves the evidence base on which the quality assurance of courses is based and produces more transparent, repeatable decisions.

What it really does is highlight, however, is to show not only how commonly, but often at which level of depth or context the competencies are embedded in the curriculum, but where competency development is concentrated or absent. The chapter-level approach goes beyond conventional course mapping by indicating which units on the curriculum contribute to priority competencies with relevance to these units, with units that require enrichment, restructuring, or reinforcement in learning activities or assessment. When connected to employer expectations, these findings may also justify targeted redesign decisions closely tied to employability, rather than broad and general curriculum adjustments.

Alternatively, at an implementation level, the framework could be used as a repeatable quality assurance process for regular curriculum review (e.g., annually or per accreditation cycle). It will enable program committees to prioritize curricular updates, allocate their workload more evenly across courses and improve cohesion between intended learning outcomes, content delivered, and assessment. Moreover, the fact that employer and student feedback is utilized simultaneously adds an input feedback layer of validation and enables institutions to interpret syllabus-based indicators against actual labor market needs and learner experience. Future research should extend the assessment to multi-institution datasets and compare alignment phenomena across different programs and disciplines.

Furthermore, weighing approaches for ω_j and α, β, γ should be fine-tuned according to more rigorous processes (e.g., expert elicitation, analytic hierarchy methods, sensitivity analysis), to enhance the robustness and interpretability of OQI. Finally, including additional sources of evidence (beyond syllabus evidence; assessment tasks, grading rubrics, student work samples, internship performance data, and learning outcome validation) could improve the measurement accuracy of competency alignment and contribute towards the value of the framework designed for continuous improvement and evaluation based on accreditation criteria.

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