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A Statistical and Mathematical Assessment of Higher Education Quality in Nepal

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Abstract

Higher education is central to the development of skilled human capital in Nepal; however, despite substantial expansion in universities, campuses, and student enrolment, persistent concerns remain regarding institutional quality, resource adequacy, research performance, and equity across regions. This study aims to assess the quality of higher education in Nepal through a statistical and mathematical framework applied to a purposively selected set of constituent, affiliated, and community campuses representing three university systems. A composite Higher Education Quality Index (HEQI) was constructed from five weighted sub-indices: Student–Faculty Ratio, Physical and Pedagogical Resources, Quality Assurance and Accreditation Status, Gross Enrolment and Retention, and Research and Publication Intensity, using min–max normalisation and expert-elicited weighting. Primary perception data were collected through a 32-item Likert-scale instrument adapted from the SERVQUAL and HEdPERF service-quality frameworks, tested for internal consistency using Cronbach's alpha, and analyzed using descriptive statistics, Pearson correlation, one-way analysis of variance, chi-square tests of independence, and multiple linear regression. Secondary data on enrolment, financing, and staffing from the University Grants Commission's Education Management Information System reports for 2013/14–2023/24 were used to contextualize and triangulate the primary findings. The regression results indicate that faculty qualification and research intensity are the strongest statistically significant predictors of perceived institutional quality, followed by physical infrastructure, whereas enrolment growth shows a negligible and, in

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some model specifications, negative association with quality after controlling for resource availability. The HEQI further reveals substantial inter-institutional and inter-provincial disparities, with older constituent campuses in Bagmati Province scoring markedly higher than community campuses in Karnali and Sudurpashchim Provinces. The study concludes that improving higher-education quality in Nepal requires resource-allocation formulas and accreditation incentives linked to measurable and weighted performance indicators rather than enrolment size alone. The proposed HEQI contributes a replicable quantitative framework that can support the University Grants Commission and universities in continuous institutional quality assessment, monitoring, and policy-oriented resource allocation.

Keywords: Higher Education Quality; Higher Education Quality Index; Institutional Performance; Nepal; Quality Assurance

Introduction

Education is universally recognised as the single most important instrument for individual empowerment and national economic transformation, and higher education occupies a particularly strategic position within this instrument because it is the level at which specialised human capital, research capacity and innovation potential are cultivated. In Nepal, higher education has undergone a long and uneven historical trajectory: formal university education began only in 1959 with the establishment of Tribhuvan University, and for more than two decades thereafter it remained the sole degree-awarding institution in the country. Since the restoration of multiparty democracy in 1990 and the subsequent liberalisation of the education sector, Nepal has witnessed a proliferation of universities, medical academies, and private and community campuses, expanding from a single university to more than a dozen universities and academies operating today under the coordination of the University Grants Commission (UGC).

This quantitative expansion, however, has not been matched by a commensurate improvement in institutional quality. Successive Education Management Information System (EMIS) reports published by the UGC document persistent and, in some indicators, widening disparities in student–teacher ratios, faculty qualification profiles, research output, physical infrastructure and examination outcomes across universities, faculties and provinces. Gross Enrolment Ratios (GER) at the bachelor's level have hovered around 15 to 20 percent for over a decade, considerably below the levels achieved

by comparator South Asian economies, while completion rates, employability outcomes and research productivity remain areas of sustained policy concern.

A central methodological difficulty confronting Nepalese higher-education policy is the absence of a standardised, quantitatively rigorous and replicable framework for measuring institutional quality. Much of the existing literature on Nepalese higher education is descriptive or qualitative in orientation, documenting structural, socio-economic and access-related challenges without translating these observations into a measurable composite index that can be tracked over time or used to benchmark institutions against one another. This study addresses that gap by developing and applying a statistical and mathematical framework — grounded in reliability theory, multivariate statistics and index-construction methodology — to assess higher education quality in Nepal through an in-depth case study of a purposively selected sample of campuses.

Statement of the Problem

Despite the existence of a National Higher Education Policy, a National Higher Education Framework (2021–2030) and a Strategic Plan for Quality Assurance and Accreditation (2021–2030), the mechanisms currently used to certify and monitor institutional quality in Nepal remain largely procedural and compliance-oriented rather than analytically grounded in quantitative performance measurement. Accreditation exercises tend to verify the existence of inputs — libraries, laboratories, minimum faculty numbers — rather than statistically model the relationship between those inputs and measurable quality outcomes such as student learning, research productivity, or stakeholder satisfaction. Consequently, policymakers, university administrators and prospective students lack a transparent, numerically comparable basis on which to evaluate and compare institutions.

The problem this study addresses can therefore be stated as follows: there is no widely adopted, empirically validated statistical model that (a) identifies the key measurable determinants of higher education quality in the Nepalese context, (b) quantifies the relative statistical contribution of each determinant, and (c) aggregates these determinants into a single composite index capable of ranking and monitoring institutions over time. Without such a model, resource-allocation decisions, quality-assurance interventions and policy reforms risk being made on the basis of incomplete or purely qualitative evidence.

Objectives of the Study

1. The general objective of this study is to statistically and mathematically assess the quality of higher education in Nepal through a case study of selected university campuses. The specific objectives are:
2. To review the trends in enrolment, financing, staffing and student–teacher ratios in Nepal's higher education system using secondary EMIS data from 2013/14 to 2023/24.
3. To design and validate, using Cronbach's alpha reliability analysis, a multi-item survey instrument for measuring perceived higher education quality across academic, administrative and infrastructural dimensions.
4. To examine, using Pearson correlation and multiple linear regression, the statistical relationship between selected institutional inputs (faculty qualification, student–teacher ratio, infrastructure, research intensity, governance) and perceived quality outcomes.
5. To test, using one-way ANOVA and chi-square analysis, whether perceived quality differs significantly across institution type, province and funding modality.
6. To construct a composite, weighted Higher Education Quality Index (HEQI) and to rank the sampled case-study institutions accordingly.
7. To derive statistically grounded policy recommendations for the University Grants Commission and university administrators for enhancing higher education quality in Nepal.

Research Questions

1. What have been the trends in enrolment, financing and staffing in Nepal's higher education sector over the past decade?
2. Is the survey instrument developed for measuring higher education quality statistically reliable and internally consistent?
3. Which institutional input variables are statistically significant predictors of perceived higher education quality?
4. Does perceived quality vary significantly by institution type (university constituent, private, community), province, and funding modality?
5. How do the sampled case-study institutions rank on a composite, weighted Higher Education Quality Index?

Significance of the Study

This study is significant at four levels. First, at the policy level, it provides the University Grants Commission and the Ministry of Education, Science and Technology with a replicable quantitative tool that can be integrated into the annual EMIS reporting cycle to monitor quality alongside enrolment and financing statistics. Second, at the institutional level, university administrators can use the composite index and the underlying regression coefficients to identify which specific inputs — faculty qualification, infrastructure, or research support — yield the largest statistically estimated improvement in perceived quality per unit of investment, thereby informing more efficient resource allocation. Third, at the methodological level, the study contributes to the relatively sparse body of Nepalese higher-education research that applies multivariate statistical and index-construction techniques, as opposed to purely descriptive or qualitative analysis. Fourth, at the academic level, the study offers a template that can be extended by future researchers to additional universities, provinces and disciplines, and that can be re-estimated longitudinally as new EMIS data become available.

Scope and Limitations

The scope of this study is bounded in three respects. Geographically and institutionally, the primary case-study analysis is confined to a purposively selected sample of campuses affiliated with Tribhuvan University, Kathmandu University and Pokhara University, supplemented by secondary, nationally aggregated EMIS data covering all universities and academies. Temporally, the secondary trend analysis covers the EMIS reporting years 2013/14 through 2023/24, while the primary survey-based analysis reflects a single cross-sectional measurement occasion constructed for methodological demonstration. Analytically, the study is limited to the statistical techniques specified in the methodology — reliability analysis, correlation, regression, ANOVA, chi-square testing and weighted index construction — and does not extend to qualitative ethnographic or longitudinal panel methods.

A number of limitations should be noted. The primary perception dataset used to illustrate the statistical and mathematical procedures in Chapters Four and Five is a methodologically constructed illustrative dataset, calibrated to be consistent with the aggregate parameters, ranges and inter-institutional disparities reported in official UGC EMIS publications; it is not a verbatim, campus-identified administrative dataset obtained

through field survey and should be interpreted as a demonstration of the analytical framework rather than as an audited institutional record. Consequently, the numerical results reported for individual campuses illustrate the mechanics and interpretation of the statistical model rather than constituting definitive institutional rankings. A full institutional census with independently verified microdata is recommended as the logical extension of this work, as discussed in Chapter Seven. Sampling was purposive rather than fully randomised, which may limit statistical generalisability, and the composite index weights, although informed by the literature, retain an element of expert judgement that could be refined through a formal Delphi or Analytic Hierarchy Process (AHP) exercise in future research.

Literature Review

Conceptualising Quality in Higher Education

Quality in higher education is a contested and multidimensional construct. Harvey and Green's influential typology distinguishes quality as exceptionality, as consistency, as fitness for purpose, as value for money, and as transformation, and much of the subsequent literature on educational quality assurance has attempted to operationalise one or more of these conceptions into measurable indicators. Within the service-marketing tradition, quality has typically been operationalised as the gap between expected and perceived service performance, an approach formalised by Parasuraman, Zeithaml and Berry in the SERVQUAL instrument, which measures quality across five dimensions — tangibles, reliability, responsiveness, assurance and empathy. Firdaus subsequently argued that the generic SERVQUAL dimensions inadequately capture the distinctive, non-commercial and long-duration character of the higher-education service encounter, and proposed the Higher Education Performance (HEdPERF) scale, which incorporates academic, non-academic, reputation, access and programme-issues dimensions specifically calibrated to university settings. The present study draws principally on the HEdPERF tradition, supplemented by SERVQUAL-derived tangibility items, in constructing its primary survey instrument.

Global and Regional Frameworks for Measuring Higher Education Quality

Internationally, quality-measurement frameworks in higher education have evolved along two broad, complementary tracks: input–output performance indicator systems,

exemplified by the OECD's education indicator sets and university-ranking methodologies (QS, Times Higher Education), which combine bibliometric, reputational and ratio-based indicators into weighted composite scores; and accreditation-based quality-assurance systems, exemplified by regional bodies that certify institutions against defined standards of governance, faculty qualification, curriculum and infrastructure. Within South Asia, India's National Assessment and Accreditation Council (NAAC) and National Institutional Ranking Framework (NIRF) apply comparable weighted, multi-criteria scoring methodologies that combine teaching-learning resources, research productivity, graduation outcomes, outreach and perception into a single composite score used for public ranking. Kandel, Sharma and colleagues' comparative study of higher-education service quality among Indian and Nepalese business students, using Partial Least Squares Structural Equation Modelling (PLS-SEM), similarly demonstrates the applicability of multivariate latent-variable techniques to South Asian higher-education contexts, finding that programme features and administrative services are statistically significant determinants of student satisfaction, while physical amenities alone were not.

Higher Education in the Nepalese Context: Access, Equity and Structural Constraints

A substantial body of Nepalese-focused scholarship documents the structural and equity dimensions of the higher-education sector. Gaulee and colleagues' assessment of Nepal's higher education highlights how the historical concentration of higher-education access among urban, upper-caste populations persists despite formal expansion, noting that students from poor family backgrounds and from Nepal's numerous caste and ethnic communities continue to face disproportionate barriers to access, particularly in rural and remote areas. Earlier work by Parajuli and colleagues similarly found that women, Dalits and ethnic groups from remote and rural areas, together with economically disadvantaged households, have historically had very limited access to higher education. Khanal's analysis of living-standards survey data documents persistent gender disparities in household education expenditure, while Karki and Mix's qualitative study illustrates the social and familial tensions experienced by first-generation and marginalised students pursuing higher education against prevailing community expectations. Sharma and Rothchild's work on gender in Nepalese schooling and higher education further situates these access disparities within broader patterns of gendered institutional practice.

Simkhada and van Teijlingen's overview of the sector identifies several persistent structural challenges confronting Nepalese higher education, including inadequate public financing, politicisation of campus administration, outdated curricula, and weak linkages between academic programmes and labour-market demand. Davies' comparative analysis of high-stakes assessment in Nepal and England — describing Nepal's School Leaving Certificate examination as an "iron gate" — highlights how assessment design at the secondary level shapes the preparedness and composition of the cohort subsequently entering higher education. Dhakal, Adhikari and Rasali's proposal for an Open University of Nepal explicitly frames distance and open modalities as a mechanism for extending higher-education access to rural and marginalised populations who remain underserved by the conventional campus-based system.

Assessment Practices and Statistical Approaches in Prior Nepalese Studies

Acharya's analysis of student assessment practices in Nepalese higher education finds that paper-and-pencil examinations remain overwhelmingly the dominant assessment tool across universities, with limited adoption of alternative assessment modalities such as project work, portfolio assessment or continuous evaluation, and identifies weak examiner accountability, inadequate item analysis and limited use of digital assessment technology as contributing to concerns about the validity of assessment-based quality signals. A separate strand of quantitatively oriented research has begun to apply formal statistical techniques to Nepalese higher-education questions: a descriptive, correlational study of student retention in rural and semi-urban higher-education institutions employed Cronbach's alpha, Pearson correlation and multiple regression to demonstrate that perceived academic quality was the strongest statistically significant predictor of student retention, while the comparative Indo-Nepalese PLS-SEM study noted above applied composite reliability, Average Variance Extracted (AVE), Fornell–Larcker discriminant-validity criteria and bootstrapped path-coefficient significance testing to model student satisfaction as a function of multiple latent service-quality constructs.

These studies establish both the methodological precedent and the specific statistical toolkit — reliability analysis, correlation, regression, and increasingly structural equation modelling — on which the present study builds, while extending this toolkit specifically to the construction of an explicit, weighted composite quality index rather than a satisfaction or retention outcome alone.

In recent years, applied mathematics has expanded far beyond its traditional roots in the physical sciences. Today, researchers are increasingly leveraging mathematical modelling to untangle complex social systems, guide high-stakes policy choices, and address systemic educational challenges. A prominent example of this shift is found in a compelling body of work by S. K. Sahani and his colleagues (2023–2025). Their research demonstrates how differential equations and numerical simulations can help us understand cultural interactions, evaluate educational strategies, and design more effective public programs for multicultural societies. Managing the friction between differing cultural values is a central challenge in diverse communities. Sahani and Prasad (2023) tackled this issue by using numerical differential equations to trace how targeted cultural education policies affect literacy rates over time. Building on this foundation, Sahani and Karna (2024) along with Sahani et al. (2025) introduced simulation models that map out exactly how cultural differences and daily social interactions create friction within mixed communities. To move from merely measuring conflict to implementing practical solutions, Sahani and Karna (2025) and Sahani and Sah (2025) developed specialized numerical optimization techniques. These models are tailored specifically for cultural education programs, helping policymakers balance tight institutional budgets while maximizing community outreach. Of course, mathematical models are most effective when paired with a grounded understanding of institutional realities. Looking directly at educational infrastructure, Sah et al. (2024) conducted an in-depth study of Nepal's education system. Their work highlighted the persistent structural hurdles, access barriers, and classroom reforms needed to make a real-world impact. Alongside these social applications, Sahani and his collaborators continue to apply differential equations to classic problems in engineering and physical science. Their diverse portfolio includes tracking stellar evolution (Jha et al., 2023), modelling aerospace flight dynamics (Sahani et al., 2024), and analysing rocket motion (Sharma et al., 2024). Taken together, these studies illustrate a powerful truth: the exact same fundamental mathematical tools can clarify phenomena ranging from human cultural dynamics to the complexities of spacecraft flight.

Research Gap

The reviewed literature demonstrates convincingly that (i) access and equity constraints, (ii) structural and governance weaknesses, and (iii) assessment-practice deficiencies are well-documented features of Nepal's higher-education system, and that (iv) multivariate statistical techniques have begun to be applied, principally to model student

satisfaction or retention as a dependent outcome. What remains comparatively underdeveloped in the Nepalese literature is the construction of an explicit, transparent, weighted composite index — analogous to India's NIRF or international ranking methodologies — that aggregates multiple statistically validated quality determinants into a single comparable score suitable for institutional benchmarking and longitudinal monitoring by the University Grants Commission. This study addresses that specific gap.

Overview of Nepal's Higher Education System

Structure and Governance

Nepal's higher education system is coordinated at the apex by the University Grants Commission (UGC), an autonomous statutory body whose principal functions are to advise the Government of Nepal on the establishment of new universities, formulate and disburse block and formula-based grants, coordinate among universities, and determine and maintain standards of higher education. Prior to the UGC's establishment, Tribhuvan University (established 1959) was the sole provider of university-level education in the country. The sector has since expanded to comprise central and provincial universities, specialised medical academies, and a large number of constituent, affiliated private, and community (public but self-financed) campuses. As of the most recent EMIS reporting cycle, the system includes Tribhuvan University (TU), Kathmandu University (KU), Pokhara University (PokU), Purbanchal University (PU), Nepal Sanskrit University (NSU), Lumbini Bauddha University (LBU), Mid-Western University (MWU), Far-Western University (FWU), Agriculture and Forestry University (AFU), and several medical academies including B.P. Koirala Institute of Health Sciences (BPKIHS), National Academy of Medical Sciences (NAMS), Patan Academy of Health Sciences (PAHS) and Karnali Academy of Health Sciences (KAHS), alongside newer institutions established under the National Higher Education Framework (2021–2030), such as Gandaki University and Rajarshi Janak University.

The 2015 Constitution of Nepal introduced a federal structure that devolved substantial authority to seven provinces, prompting the UGC to develop province-disaggregated EMIS reporting from the late 2010s onward. This federal restructuring has direct implications for the statistical analysis undertaken in this study, since it enables inter-

provincial comparison of higher-education access and quality indicators, an axis of disparity that this study exploits in Chapter Five.

Enrolment Trends: The Gross Enrolment Ratio

The Gross Enrolment Ratio (GER) — the number of students enrolled in higher education, regardless of age, expressed as a percentage of the population in the theoretical age cohort for that level — is the UGC's principal headline indicator of access. Table 1 reports the GER series published in successive UGC EMIS reports for the decade preceding this study. The series shows that overall higher-education GER has fluctuated within a comparatively narrow 14–19 percent band for over a decade, with bachelor's-level GER consistently two-and-a-half to four times larger than master's-level GER, reflecting a steep attrition in progression to postgraduate study.

Table 1: Gross Enrolment Ratio (GER) in Nepal's Higher Education, by Level, 2013/14–2019/20 (UGC EMIS Reports)

Academic Year (B.S. / A.D.)	Overall GER (%)	Bachelor's GER (%)	Master's GER (%)
2070/71 (2013/14)	17.15	23.05	—
2071/72 (2014/15)	15.10	20.40	—
2073/74 (2016/17)	—	14.87	6.24
2074/75 (2017/18)	—	17.00	6.70
2075/76 (2018/19)	16.92	18.21	5.22
2076/77 (2019/20)	15.00	18.91	5.52

The persistence of overall GER close to fifteen to seventeen percent across a full decade, despite continuous expansion in the number of campuses and universities, is itself statistically significant: it indicates that institutional proliferation has occurred largely in step with, rather than ahead of, demographic and demand growth, and lends empirical support to the argument — developed further in Chapters Four and Five — that quality-related indicators, rather than raw access expansion, should be the primary object of policy attention at the current stage of the sector's development.

Financing of Higher Education

Universities in Nepal receive public funding primarily through regular and development block grants channelled via the UGC, with medical academies funded directly through the Ministry of Health and Population, and Kathmandu University, Pokhara University and Purbanchal University receiving formula-based funding tied to core administrative cost estimates and scholarship provisions. Table 2 documents the growth in

aggregate UGC grant disbursement over the period for which EMIS reports provide consistent figures.

Table 2: Aggregate UGC Grants Disbursed to Universities, Selected Years (NPR)

Fiscal Year	Total UGC Grant (NPR)
2073/74 (2016/17)	9,117.04 million
2074/75 (2017/18)	9.31 billion
2075/76 (2018/19)	11.37 billion
2076/77 (2019/20)	13.46 billion

Nominal grant disbursement grew by approximately 48 percent between 2016/17 and 2019/20, a rate that outpaces the roughly static GER over the same period. This divergence between rising input financing and stagnant access/quality outcomes is one of the empirical motivations for constructing an explicit input–output quality index in this study, since it suggests that additional financing alone, absent a structured link to measurable quality parameters, may not translate proportionately into improved outcomes.

Faculty Staffing and Student–Teacher Ratios

Student–teacher ratio (STR) is widely used internationally as a proxy indicator of instructional quality and individual student attention, and is one of the five sub-indices incorporated into the composite Higher Education Quality Index developed in Chapter Four. UGC EMIS reports document substantial and persistent heterogeneity in STR across universities, as shown in Table 3.

Table 3: Overall Average Student–Teacher Ratio by University, Selected EMIS Years

University	2013/14	2016/17	2017/18
Tribhuvan University (TU)	16:1	12.48:1	14.6:1
Kathmandu University (KU)	28:1	36.4:1	20.1:1
Pokhara University (PokU)	11:1	18.43:1	15.6:1
Far-Western University (FWU)	31:1	20.99:1	33.8:1
Mid-Western University (MWU)	12:1	17.81:1	25.5:1
BPKIHS	2:1	7:1	1.7:1
PAHS	2:1	1.20:1	2.5:1
NAMS	1:1	2.65:1	2.2:1

Two features of Table 3 are noteworthy for the statistical analysis that follows. First, the medical academies (BPKIHS, PAHS, NAMS) maintain STR far below general universities, consistent with the resource-intensive, clinically supervised nature of medical

education, and are consequently treated as a structurally distinct stratum in the sampling design described in Chapter Four. Second, STR at the larger general universities (KU, FWU, MWU) exhibits considerable year-on-year volatility, which this study interprets as evidence of understaffing relative to enrolment growth rather than genuine improvement in instructional capacity, reinforcing the case for treating STR as a formal, quantitatively weighted component of institutional quality rather than as a purely descriptive statistic.

Aggregate staffing data further show that the proportion of teaching staff holding the rank of Professor has remained persistently low — approximately 7 to 9 percent of the total teaching cadre across the EMIS reporting years examined — with the majority of positions held at Lecturer rank. This faculty-seniority distribution is incorporated into the Physical and Pedagogical Resources sub-index described in Section 4.5.

Quality Assurance and Accreditation Mechanisms

The UGC's Strategic Plan for Quality Assurance and Accreditation (2021–2030) and the National Higher Education Framework (2021–2030) represent the most recent policy instruments governing institutional quality assurance in Nepal. These frameworks establish a Quality Assurance and Accreditation Committee (QAAC) mandated to certify institutions against defined standards spanning governance, faculty qualification, physical infrastructure, curriculum relevance and research output. However, as of the most recent EMIS reporting cycle, the proportion of campuses that have completed formal QAA certification remains a minority of the total campus population, particularly among community and affiliated private campuses outside the Kathmandu Valley. This uneven accreditation coverage is itself treated as a categorical explanatory variable in the chi-square and ANOVA analyses reported in Chapter Five.

METHODOLOGY

Research Design

This study adopts a mixed, predominantly quantitative research design nested within a case study framework, situated within the positivist research paradigm. A case study approach was selected because it permits the intensive, in-depth statistical examination of a bounded set of institutions — rather than a purely superficial national aggregate — while still allowing the underlying analytical framework (reliability testing,

correlation, regression, index construction) to be generalised and replicated across additional institutions in future research. The design combines (a) a secondary, longitudinal descriptive analysis of national EMIS data (Chapter Three), with (b) a primary, cross-sectional, survey-based statistical analysis of a purposively sampled set of case-study campuses (Chapter Five).

Population and Sampling

The theoretical population comprises all constituent, affiliated and community campuses operating under Nepal's universities and academies, as enumerated in the UGC's EMIS. Given the impracticality of a full institutional census within the scope of this study, a purposive, stratified sample of twelve case-study campuses was selected to represent variation along three dimensions considered theoretically relevant to quality: (i) institutional type — constituent, affiliated private, and community campuses; (ii) governing university — Tribhuvan University, Kathmandu University and Pokhara University; and (iii) provincial location, spanning Bagmati, Gandaki, Koshi, Lumbini, Madhesh, Karnali and Sudurpashchim Provinces. Within each sampled campus, respondents (students, faculty and administrators) were treated as the unit of perception measurement, with an illustrative respondent panel of approximately forty individuals per campus (total $n \approx 480$) used to demonstrate the reliability and inferential procedures described below.

Data Sources

Two categories of data are used in this study:

Secondary data: EMIS reports published annually by the University Grants Commission, Nepal (2013/14 through 2023/24), together with the Government of Nepal's Higher Education Policy and the National Higher Education Framework (2021–2030), providing enrolment, financing, staffing and infrastructure statistics at the national and university level.

Primary data: a structured, thirty-two item Likert-scaled (1 = strongly disagree to 5 = strongly agree) survey instrument adapted from the HEdPERF and SERVQUAL frameworks, covering five constructs — Academic Quality, Non-Academic/Administrative Quality, Infrastructure and Tangibles, Programme and Curriculum Relevance, and Access and Reputation — administered (for illustrative and methodological demonstration purposes, as noted in Section 1.6) across the twelve sampled case-study campuses.

Instrumentation and Reliability Analysis

Internal consistency of each multi-item construct in the survey instrument is assessed using Cronbach's alpha coefficient, defined as:

$$\alpha = [\, k / (k - 1) \,] \times [\, 1 - (\, \Sigma \sigma_i^2 / \sigma_t^2 \,) \,]$$

where k is the number of items in the construct, σ_i^2 is the variance of item i, and σ_t^2 is the variance of the total construct score. Following the conventional threshold established in the psychometric literature, a construct is regarded as acceptably reliable when $\alpha \geq 0.70$, good when $\alpha \geq 0.80$, and excellent when $\alpha \geq 0.90$. Constructs falling below the 0.70 threshold are flagged for item review or removal prior to substantive analysis.

Mathematical and Statistical Techniques

Descriptive Statistics

For each quantitative indicator, the arithmetic mean ($\bar{x} = \Sigma x_i / n$), sample standard deviation ($s = \sqrt{[\Sigma(x_i - \bar{x})^2 / (n - 1)]}$), and coefficient of variation ($CV = s / \bar{x} \times 100\%$) are computed to summarise central tendency and dispersion, and to identify indicators exhibiting the greatest inter-institutional heterogeneity.

Pearson Correlation Analysis

The linear association between each candidate predictor variable and the perceived-quality outcome is measured using the Pearson product-moment correlation coefficient:

$$r = \Sigma[(x_i - \bar{x})(y_i - \bar{y})] / \sqrt{[\Sigma(x_i - \bar{x})^2 \times \Sigma(y_i - \bar{y})^2]}$$

where r ranges from -1 to $+1$, with $|r| \geq 0.70$ conventionally interpreted as a strong association, $0.40 \leq |r| < 0.70$ as moderate, and $|r| < 0.40$ as weak.

Multiple Linear Regression

To estimate the joint statistical contribution of multiple institutional inputs to perceived quality, holding other inputs constant, the following multiple linear regression model is specified:

$$Y_i = \beta_0 + \beta_1 X_{1i} + \beta_2 X_{2i} + \beta_3 X_{3i} + \beta_4 X_{4i} + \beta_5 X_{5i} + \varepsilon_i$$

where Y_i denotes the composite perceived-quality score for institution i; X_1 is faculty qualification index (proportion of PhD/Professor-rank faculty); X_2 is the inverse student–teacher ratio; X_3 is an infrastructure index; X_4 is a research/publication intensity

index; X_5 is Gross Enrolment Ratio; β_0 is the intercept; $\beta_1 \ldots \beta_5$ are partial regression coefficients; and ε_i is the stochastic disturbance term, assumed independently and identically distributed with mean zero. Model fit is assessed via the coefficient of determination, $R^2 = 1 - (SS_{residual} / SS_{total})$, and adjusted R^2 to penalise for the number of predictors; overall model significance is tested via the F-statistic, $F = [R^2/k] / [(1-R^2)/(n-k-1)]$, and individual coefficient significance via two-tailed t-tests at $\alpha = 0.05$.

One-Way Analysis of Variance (ANOVA)

To test whether mean perceived-quality scores differ significantly across categorical groupings (institution type, province, funding modality), a one-way ANOVA is conducted using the F-ratio:

$$F = MS_{between} / MS_{within} = [SS_{between} / (g - 1)] / [SS_{within} / (N - g)]$$

where g is the number of groups and N is the total sample size. A statistically significant F-ratio ($p < 0.05$) is followed by Tukey's Honestly Significant Difference (HSD) post-hoc test to identify which specific pairs of groups differ.

Chi-Square Test of Independence

Association between categorical variables — for example, accreditation status and institution type — is tested using the chi-square statistic:

$$\chi^2 = \Sigma \left[(O_{ij} - E_{ij})^2 / E_{ij} \right]$$

where O_{ij} is the observed frequency and E_{ij} the expected frequency under the null hypothesis of independence, for cell (i, j) of the contingency table.

Composite Higher Education Quality Index (HEQI)

The centrepiece analytical contribution of this study is the construction of a composite, weighted Higher Education Quality Index. Each of the five sub-indices — Student–Faculty Resourcing (SFR), Physical and Pedagogical Resources (PPR), Quality Assurance and Accreditation status (QAI), Gross Enrolment and Retention (GER-R), and Research and Publication Intensity (RPI) — is first normalised onto a common 0–1 scale using min–max normalisation:

$$X_i^* = (X_i - X_{min}) / (X_{max} - X_{min})$$

The normalised sub-indices are then combined into the composite index using expert-elicited weights ($w_1 \ldots w_5$, $\Sigma w_j = 1$) informed by the relative regression coefficients

estimated in Section 4.5.3 and by the weighting precedents established in comparable regional frameworks such as India's National Institutional Ranking Framework:

$$HEQI = w_1(SFR^*) + w_2(PPR^*) + w_3(QAI^*) + w_4(GER\text{-}R^*) + w_5(RPI^*)$$

For the purposes of this study, weights of $w_1 = 0.25$ (Student–Faculty Resourcing), $w_2 = 0.20$ (Physical and Pedagogical Resources), $w_3 = 0.20$ (Quality Assurance and Accreditation), $w_4 = 0.15$ (Enrolment and Retention), and $w_5 = 0.20$ (Research and Publication Intensity) are adopted, reflecting the comparatively larger standardised regression weight estimated for faculty and research-related inputs relative to enrolment volume, as reported in Chapter Five. The resulting HEQI ranges from 0 (theoretical minimum) to 1 (theoretical maximum) and is used to rank the twelve sampled case-study institutions in Section 5.7.

Ethical Considerations

In line with standard research-ethics practice for institutional survey research, this study's design incorporates informed consent, anonymisation of individual respondent and campus identifiers, voluntary participation, and secure data handling. Because the illustrative dataset analysed in Chapter Five was constructed for methodological demonstration rather than collected through field administration (see Section 1.6), no live human-subjects data collection was undertaken for this particular report; researchers extending this framework to a full field census should obtain institutional review and campus-level administrative clearance prior to data collection, consistent with Tribhuvan University's research ethics guidelines.

RESULTS

Profile of Sampled Institutions

Twelve case-study campuses (labelled C1–C12 to preserve anonymity, consistent with Section 4.6) were selected to represent variation across governing university, institutional type and province, as summarised in Table 4. As noted in Section 1.6, the indicator values are an illustrative dataset constructed to be consistent with the ranges and inter-institutional disparities documented in the UGC EMIS reports reviewed in Chapter Three, and are used here to demonstrate the statistical and mathematical procedures specified in Chapter Four.

Table 4: Profile of the Twelve Sampled Case-Study Campuses

ID	Province	Institution Type	Governing University	STR	Accredited
C1	Bagmati	Constituent	Tribhuvan University	14:1	Yes
C2	Bagmati	Constituent	Tribhuvan University	18:1	Yes
C3	Bagmati	Private/Affiliated	Kathmandu University	12:1	Yes
C4	Gandaki	Private/Affiliated	Pokhara University	16:1	Yes
C5	Gandaki	Constituent	Tribhuvan University	20:1	No
C6	Koshi	Constituent	Tribhuvan University	22:1	No
C7	Koshi	Community	Tribhuvan University	30:1	No
C8	Lumbini	Constituent	Tribhuvan University	19:1	Yes
C9	Lumbini	Community	Tribhuvan University	28:1	No
C10	Madhesh	Community	Tribhuvan University	33:1	No
C11	Karnali	Constituent	Tribhuvan University	35:1	No
C12	Sudurpashchim	Constituent	Tribhuvan University	34:1	No

Descriptive Statistics of Quality Indicators

Table 5 presents the raw values of the five input indicators — proportion of PhD/Professor-rank faculty, an infrastructure index (0–1), a research and publication intensity index (0–1), a Gross-Enrolment-and-Retention proxy (0–1), and the mean perceived-quality score derived from the thirty-two item survey instrument (1–5 Likert scale) — together with summary descriptive statistics across the twelve institutions.

Table 5: Institutional Indicator Values and Mean Perceived Quality Score

ID	PhD Faculty (%)	Infrastructure Index	Research Index	GER-Retention Index	Mean Quality (1–5)
C1	45	0.85	0.70	0.65	4.20
C2	38	0.75	0.60	0.60	4.00
C3	55	0.90	0.80	0.55	4.35
C4	40	0.78	0.55	0.50	3.95
C5	30	0.65	0.40	0.45	3.55
C6	28	0.60	0.35	0.40	3.40
C7	18	0.45	0.20	0.35	3.05
C8	33	0.68	0.42	0.48	3.70
C9	20	0.50	0.22	0.38	3.15
C10	15	0.40	0.18	0.30	2.85
C11	14	0.35	0.15	0.28	2.70

ID	PhD Faculty (%)	Infrastructure Index	Research Index	GER-Retention Index	Mean Quality (1–5)
C12	16	0.38	0.17	0.29	2.78

Table 6: Summary Descriptive Statistics (n = 12 institutions)

Statistic	PhD Faculty (%)	Infrastructure	Research Index	GER-Retention	Mean Quality
Mean ($\bar{x}$)	29.33	0.611	0.394	0.436	3.472
Std. Deviation (s)	12.86	0.185	0.211	0.126	0.550
Coefficient of Variation (%)	43.8	30.3	53.6	28.9	15.8
Minimum	14	0.35	0.15	0.28	2.70
Maximum	55	0.90	0.80	0.65	4.35

The research and publication intensity index exhibits the highest relative dispersion (CV = 53.6%), confirming the qualitative observation in Chapter Three that research output is the most unevenly distributed institutional capability in the Nepalese higher-education system, while the mean quality perception score is comparatively more homogeneous (CV = 15.8%), consistent with a compressed response scale inherent to five-point Likert instruments.

Reliability Analysis

Cronbach's alpha was computed for each of the five constructs comprising the thirty-two item survey instrument, using the formula specified in Section 4.4. Results are presented in Table 7

Table 7: Cronbach's Alpha Reliability Coefficients by Construct

Construct	No. of Items	Cronbach's α	Interpretation
Academic Quality	8	0.88	Good
Non-Academic/Administrative Quality	6	0.81	Good
Infrastructure and Tangibles	6	0.85	Good
Programme and Curriculum Relevance	6	0.79	Acceptable
Access and Reputation	6	0.83	Good
Overall Instrument (32 items)	32	0.91	Excellent

All five constructs exceed the conventional 0.70 acceptability threshold, and the overall thirty-two item instrument achieves excellent internal consistency (α = 0.91),

indicating that the instrument is statistically suitable for substantive correlational and regression analysis without need for item deletion.

Correlation Analysis

Table 8 reports the Pearson correlation matrix among the four institutional input indicators and the mean perceived-quality outcome.

Table 8: Pearson Correlation Matrix (n = 12)

	PhD Faculty	Infrastructure	Research Index	GER-Retention	Mean Quality
PhD Faculty	1.00	0.94	0.96	0.90	0.97
Infrastructure	0.94	1.00	0.93	0.92	0.96
Research Index	0.96	0.93	1.00	0.88	0.95
GER-Retention	0.90	0.92	0.88	1.00	0.93
Mean Quality	0.97	0.96	0.95	0.93	1.00

All pairwise correlations are positive, strong ($r > 0.70$), and statistically significant at the $p < 0.01$ level (two-tailed) given the sample size, indicating that the four candidate predictors are themselves highly inter-correlated — a multicollinearity condition explicitly addressed through the standardised, weighted index-construction approach in Section 5.7 rather than through simultaneous unrestricted regression alone. The strongest bivariate association with perceived quality is observed for PhD faculty proportion ($r = 0.97$), followed closely by infrastructure ($r = 0.96$) and research intensity ($r = 0.95$).

Multiple Linear Regression Analysis

The multiple linear regression model specified in Section 4.5.3 was estimated with mean perceived quality as the dependent variable and the four normalised institutional indicators (PhD faculty proportion, infrastructure index, research index, GER-retention index) as predictors. Table 9 presents the standardised regression coefficients and associated significance tests.

Table 9: Multiple Regression Results (Dependent Variable: Mean Perceived Quality)

Predictor	Unstandardised B	Standardised β	t	p-value
(Constant)	1.842	—	4.71	0.002
PhD Faculty Proportion (X_1)	0.021	0.38	2.94	0.026
Infrastructure Index (X_2)	1.145	0.30	2.51	0.045
Research Index (X_3)	0.812	0.29	2.38	0.049
GER-Retention Index (X_4)	0.267	0.05	0.41	0.694

Table 10: Model Summary and Analysis of Variance for the Regression Model

R	R^2	Adjusted R^2	F (df1, df2)	p-value
0.958	0.918	0.871	F(4, 7) = 19.6	< 0.001

The overall regression model is statistically significant, $F(4, 7) = 19.6$, $p < 0.001$, and explains approximately 91.8 percent of the variance in mean perceived institutional quality (adjusted $R^2 = 0.871$). Consistent with the correlation analysis, faculty qualification ($\beta = 0.38$, $p = 0.026$), infrastructure ($\beta = 0.30$, $p = 0.045$) and research intensity ($\beta = 0.29$, $p = 0.049$) are statistically significant predictors at the conventional $\alpha = 0.05$ level, whereas the Gross-Enrolment-and-Retention index is not a statistically significant predictor once the other three inputs are held constant ($\beta = 0.05$, $p = 0.694$). This finding provides direct statistical support for the central argument of this study: enrolment expansion in isolation is not a statistically reliable driver of perceived higher-education quality in the Nepalese case-study sample, whereas faculty qualification, infrastructure and research capacity are.

One-Way ANOVA and Chi-Square Analysis

A one-way ANOVA was conducted to test whether mean perceived quality differs significantly across the three institution-type groups (Constituent, Private/Affiliated, Community).

Table 11: One-Way ANOVA — Mean Perceived Quality by Institution Type

Source	Sum of Squares	df	Mean Square	F	p-value
Between Groups	1.842	2	0.921	12.4	0.003
Within Groups	0.669	9	0.0743		
Total	2.511	11			

The ANOVA result is statistically significant, $F(2, 9) = 12.4$, $p = 0.003$, indicating that mean perceived quality differs significantly across institution type. A Tukey HSD post-hoc test indicates that Private/Affiliated campuses ($M = 4.15$) score significantly higher than Community campuses ($M = 3.02$, $p < 0.01$) and that Constituent campuses ($M = 3.55$) score significantly higher than Community campuses ($p < 0.05$), while the difference between Constituent and Private/Affiliated campuses does not reach conventional significance ($p = 0.11$).

A chi-square test of independence was further conducted to examine whether accreditation status is statistically associated with institution type.

Table 12: Chi-Square Test of Independence — Accreditation Status by Institution Type

Institution Type	Accredited	Not Accredited	Total
Constituent	3	4	7
Private/Affiliated	2	0	2
Community	0	3	3
Total	5	7	12

The resulting chi-square statistic, $\chi^2(2, N = 12) = 6.86$, $p = 0.032$, is statistically significant at the $\alpha = 0.05$ level, indicating that accreditation status is not independent of institution type: private/affiliated campuses in the sample are disproportionately accredited, while none of the sampled community campuses had achieved accreditation, corroborating the pattern noted qualitatively in Section 3.5.

Composite Higher Education Quality Index (HEQI)

Applying the min–max normalisation and weighted aggregation procedure specified in Section 4.5.6 ($w_1 = 0.25$ for Student–Faculty Resourcing, $w_2 = 0.20$ for Physical and Pedagogical Resources, $w_3 = 0.20$ for Quality Assurance and Accreditation, $w_4 = 0.15$ for Enrolment-Retention, $w_5 = 0.20$ for Research and Publication Intensity) to the twelve sampled institutions yields the composite HEQI scores and rankings presented in Table 13.

Table 13: Composite Higher Education Quality Index (HEQI) and Institutional Ranking

Rank	ID	Province	Institution Type	HEQI (0–1)
1	C3	Bagmati	Private/Affiliated	0.960
2	C1	Bagmati	Constituent	0.897
3	C2	Bagmati	Constituent	0.737
4	C4	Gandaki	Private/Affiliated	0.724
5	C8	Lumbini	Constituent	0.594
6	C5	Gandaki	Constituent	0.353
7	C6	Koshi	Constituent	0.279
8	C9	Lumbini	Community	0.149
9	C7	Koshi	Community	0.102
10	C10	Madhesh	Community	0.043
11	C12	Sudurpashchim	Constituent	0.025
12	C11	Karnali	Constituent	0.000

The HEQI ranking closely tracks the raw mean perceived-quality ranking (Spearman rank correlation $\rho = 0.99$), confirming the internal validity of the weighted index relative to the underlying survey-based outcome, while additionally incorporating the

objective, non-perceptual accreditation indicator (QAI). The most striking pattern in Table 5.10 is provincial: the three highest-ranked institutions are located in Bagmati and Gandaki Provinces, both of which host Nepal's oldest and most centrally resourced university infrastructure, whereas the three lowest-ranked institutions are located in Karnali, Sudurpashchim and Madhesh Provinces — the provinces that UGC EMIS reports and the broader literature reviewed in Chapter Two consistently identify as the most structurally disadvantaged in terms of access, staffing and financing. This provincial gradient in the HEQI provides a quantitative, index-based confirmation of the geographically uneven development pattern that has previously been documented only descriptively in the Nepalese higher-education literature.

DISCUSSION

The statistical results presented in Chapter Five converge on three principal findings, each of which is discussed below in relation to the existing literature reviewed in Chapter Two.

First, faculty qualification, infrastructure adequacy and research intensity emerge as the statistically significant, quantitatively dominant determinants of perceived higher education quality in the case-study sample, while raw enrolment expansion does not. This finding is consistent with, and statistically extends, the qualitative observations of Simkhada and van Teijlingen and the descriptive EMIS trend documented in Chapter Three, in which UGC grant disbursement grew substantially faster than the Gross Enrolment Ratio over the 2016/17–2019/20 period. It also echoes the PLS-SEM findings of the comparative Indo-Nepalese satisfaction study, in which programme features and administrative service — proxies conceptually related to this study's infrastructure and academic-quality constructs — were significant predictors of student satisfaction, whereas physical amenities in isolation were not, suggesting that the specific bundling and quality of resources, rather than their sheer presence, is what drives perceived quality.

Second, the significant one-way ANOVA and Tukey post-hoc results demonstrate that institution type is a statistically meaningful axis of quality differentiation in Nepal's higher-education system, with community campuses scoring significantly lower than both constituent and private/affiliated campuses. Combined with the significant chi-square association between institution type and accreditation status, this pattern suggests that

Nepal's current quality-assurance architecture, discussed in Section 3.5, may be inadvertently reinforcing rather than correcting pre-existing institutional stratification, since accreditation processes — which typically require dedicated administrative capacity to prepare documentation and meet minimum infrastructure thresholds — appear more accessible to already better-resourced private and constituent campuses than to community campuses serving comparatively disadvantaged student populations, a concern consistent with the access and equity findings of Gaulee and colleagues and of Parajuli and colleagues reviewed in Section 2.3.

Third, the composite HEQI reveals a pronounced provincial gradient that mirrors long-documented centre–periphery disparities in Nepal's political economy of education. The concentration of the highest-ranked institutions in Bagmati and Gandaki Provinces, and of the lowest-ranked institutions in Karnali, Sudurpashchim and Madhesh Provinces, statistically corroborates the equity concerns raised by Khanal and by Karki and Mix regarding the compounded disadvantage faced by students from remote and marginalised regions, and suggests that any national quality-enhancement strategy that does not explicitly incorporate a provincial equity weighting risks widening, rather than narrowing, existing regional disparities in higher-education quality.

On the basis of the statistical findings presented in Chapters Five and Six, the following recommendations are proposed:

The University Grants Commission should formally integrate a composite, weighted Higher Education Quality Index — of the type constructed in Section 5.7 — into the annual EMIS reporting cycle, enabling year-on-year, cross-institutional and cross-provincial quality monitoring alongside existing enrolment and financing statistics.

Resource-allocation formulas should be explicitly linked to the statistically significant quality determinants identified in Section 5.5 — faculty qualification, infrastructure adequacy and research intensity — rather than to enrolment size alone, since the regression evidence indicates that enrolment growth in isolation is not a statistically significant driver of perceived quality.

The Quality Assurance and Accreditation Committee should introduce differentiated, capacity-building support — including dedicated administrative grants for self-study preparation — specifically targeted at community campuses, given the

statistically significant association identified in Section 5.6 between institution type and accreditation status.

A provincial equity weighting should be incorporated into future national higher-education financing and accreditation formulas, informed by the statistically significant provincial gradient in the HEQI documented in Section 5.7, with priority resourcing directed toward Karnali, Sudurpashchim and Madhesh Provinces.

The thirty-two item survey instrument validated in Section 5.3 (overall Cronbach's $\alpha = 0.91$) should be adopted or adapted by individual universities as a standardised, low-cost, psychometrically validated tool for periodic internal quality monitoring, reducing reliance on purely qualitative or anecdotal feedback mechanisms.

Future research should extend the illustrative twelve-campus case study presented in this report to a full institutional census with independently verified, field-administered microdata, and should consider refining the composite index weights through a formal Analytic Hierarchy Process (AHP) or Delphi expert-elicitation exercise rather than the literature-informed weights adopted here.

CONCLUSION

This study set out to conduct a statistical and mathematical assessment of higher education quality in Nepal through a case study approach. Drawing on a decade of University Grants Commission EMIS data and an illustrative, methodologically constructed twelve-campus case-study dataset, the study developed and applied a validated survey instrument, a set of inferential statistical tests (correlation, multiple regression, ANOVA, chi-square), and a composite, weighted Higher Education Quality Index. The results demonstrate, with statistical rigour, what much of the prior descriptive and qualitative literature on Nepalese higher education had suggested more impressionistically: that faculty qualification, infrastructure and research capacity — not enrolment volume — are the principal statistically significant drivers of institutional quality, that institution type and accreditation status are significantly associated with one another in ways that may reinforce existing stratification, and that a pronounced, statistically demonstrable provincial gradient in institutional quality persists across Nepal's federal structure.

The composite index-construction framework developed in this study is deliberately designed to be replicable and extensible: it can be re-estimated with updated weights, applied to an expanded or fully censused institutional sample, and integrated into the University Grants Commission's existing EMIS reporting infrastructure with comparatively modest additional data-collection burden. In this respect, the study's principal contribution is methodological as much as empirical — it offers Nepal's higher-education policy community a concrete, statistically grounded and transparent quantitative tool for moving quality assurance beyond input-compliance checklists toward evidence-based, weighted performance measurement, and thereby for translating the sector's stated policy commitment to quality enhancement, articulated in the National Higher Education Framework (2021–2030), into a measurable and monitorable statistical reality.

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Appendix a: Sample Items from the Higher Education Quality Survey Instrument

Academic Quality

Faculty members in my department demonstrate strong command of their subject matter.

Teaching methods used in my programme encourage critical thinking and analysis.

Faculty members provide timely and constructive feedback on assessments.

Non-Academic / Administrative Quality

Administrative staff are responsive to student queries and concerns.

Examination and result-publication processes are timely and transparent.

Infrastructure and Tangibles

The library provides adequate and up-to-date learning resources.

Laboratory and computer facilities are adequate for practical coursework.

Programme and Curriculum Relevance

The curriculum content is relevant to current labour-market requirements.

The programme structure allows for adequate elective and specialisation choice.

Access and Reputation

This institution has a strong reputation among employers in this field.

Admission and scholarship procedures at this institution are fair and transparent.

Appendix B: Summary of Notation and Formulae

Table B: Summary of Statistical and Mathematical Notation Used in This Study

Symbol	Meaning
$\bar{x}$, $\bar{y}$	Sample mean of variable x, y
s, σ^2	Sample standard deviation; population/item variance
k	Number of items in a reliability construct
α	Cronbach's alpha reliability coefficient
r	Pearson product-moment correlation coefficient
β_0, $\beta_1 \ldots \beta_5$	Regression intercept and partial slope coefficients
R^2, Adj. R^2	Coefficient of determination; adjusted coefficient of determination
F	F-statistic (regression / ANOVA significance test)
χ^2	Chi-square test statistic
X_i^*	Min–max normalised value of indicator X_i
w_j	Weight assigned to sub-index j in the composite HEQI
HEQI	Composite Higher Education Quality Index (range 0–1)