Asian Journal of
Science, Technology, Engineering, and Art

e-ISSN: 3025-4507
p-ISSN: 3025-5287
Index: Harvard, Boston, Sydney University, Dimensions, Lens, Scilit, Semantic, Google, etc

https://doi.org/10.58578/AJSTEA.v4i6.12570

Mathematical Analysis of Present Status and Challenges of Higher Education in Nepal

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Submitted:	Revised:	Accepted:	Published:
Sep 22, 2026	Oct 21, 2026	Nov 1, 2026	Nov 6, 2026

Abstract

Higher education in Nepal has expanded rapidly, yet persistent challenges remain in educational quality, financing, research capacity, geographical equity, governance, infrastructure, and student progression. This study examined the sector's status and challenges through a mathematical and comparative analysis of publicly reported national data and seven selected universities: Tribhuvan University (TU), Purbanchal University, Pokhara University, Kathmandu University, Far Western University, Mid-West University, and Rajarshi Janak University. The analysis employed ratios, shares, concentration measures, growth calculations, gender-distribution measures, and normalized indicators; a composite challenge-index methodology was also proposed. The University Grants Commission's 2023/24 higher education management information report recorded 633,053 students across 1,432 campuses within 16 universities and seven medical academies. TU accounted for 491,299 students (77.61%), indicating substantial enrollment concentration. Female enrollment exceeded male enrollment in all selected universities except Pokhara University and Kathmandu University. The analysis highlights the challenge of translating institutional expansion into equitable access, high-quality learning, timely completion, productive research, and graduate employability. The study contributes a mathematical framework for jointly assessing access, equity, capacity, quality, research, and governance. It concludes that differentiated policies are needed, including large-scale reforms at TU, stronger quality assurance and research capacity at established universities, targeted capacity building at emerging institutions, and improved data systems across the sector.

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Keywords: Higher Education; Nepal; Mathematical Analysis; Enrollment Concentration; Educational Equity

Introduction

Higher education is a strategic component of national development because it supplies advanced human capital, creates and disseminates knowledge, supports innovation, and contributes to social and economic mobility. In Nepal, the higher-education system has changed from a relatively small and centralized structure into a diverse system containing central and provincial universities, medical academies, constituent campuses, affiliated private colleges and community campuses. The University Grants Commission (UGC) reports that its higher-education Education Management Information System (EMIS) is designed to provide comprehensive and standardized information on institutions, enrollment, gender parity, pass rates, graduates, teachers, financing and student-teacher ratios. This makes UGC data particularly useful for a quantitative status analysis.

The 2023/24 UGC report records 633,053 students enrolled in 1,432 campuses of 16 universities and seven medical academies. It also shows that 94.33 percent of enrollment is concentrated in the central universities and that Tribhuvan University alone contains 77.61 percent of the total higher-education enrollment. Such concentration is a defining structural characteristic of Nepalese higher education. It creates both advantages and risks: TU provides broad geographical and disciplinary access, but its scale creates exceptional pressure on examinations, academic administration, infrastructure and quality assurance.

This paper uses mathematics not as an end in itself but as a way of making structural conditions visible. Percentages reveal institutional concentration; ratios compare female and male participation; growth rates reveal expansion; concentration measures quantify dependence on dominant institutions; and composite indices can organize multiple dimensions of performance. The objective is not to create an artificial university ranking. Instead, the paper develops a transparent analytical framework that can be reproduced when better institution-level data become available.

The literature strongly establishes the importance of mathematical modelling, numerical methods, and machine learning as powerful tools for analysing and solving complex real-world problems. Sah et al. (2024) identified major challenges in Nepal's education system and emphasized the urgent need for innovative, technology-based

improvements. Likewise, Sahani and colleagues demonstrated the effectiveness of numerical approaches in understanding cultural, educational, and social phenomena.

Recent research by Sahani et al. (2026) further strengthens the evidence that integrating artificial intelligence with mathematical frameworks can significantly improve risk assessment, prediction accuracy, and decision-making processes. Overall, these studies clearly indicate that interdisciplinary computational approaches are essential for developing reliable, efficient, and data-driven solutions in modern educational, social, and management systems.

Nepal's higher-education expansion has been driven by rising demand for university qualifications, the growth of private and community provision, establishment of new public universities, and increasing participation of women. At the same time, students increasingly evaluate institutions in relation to employability, technology, international opportunities, research quality and the speed of academic services. These changes place pressure on traditional university structures that were designed for a smaller student population.

The UGC report also demonstrates strong geographic unevenness. Of 1,432 campuses, 58.94 percent are located in the Hill ecological belt, 36.10 percent in the Tarai and 4.96 percent in the Mountain region. By province, Bagmati contains 43.58 percent of campuses, while Madhesh contains 8.59 percent. This distribution matters because physical access to higher education remains linked to geography, transport, urban concentration and household resources.

Statement of the Problem

The central problem is a mismatch between quantitative expansion and qualitative consolidation. Nepal has added universities and programmes, yet differences in institutional size, teacher capacity, infrastructure, research intensity, academic administration and student outcomes remain substantial. A simple count of universities therefore gives an incomplete picture of system health.

A second problem is the dominance of aggregate indicators. National enrollment can rise even when individual universities experience stagnation or when students face longer completion times. Likewise, a high female enrollment share may indicate progress in access while concealing disciplinary or regional inequalities. Mathematical analysis is useful because it forces the researcher to examine denominators, ratios, trends and distributions rather than isolated counts.

Objectives and Research Questions

General Objective

To mathematically assess the present status, structural patterns and major challenges of higher education in Nepal through a comparative case study of selected universities.

Specific Objectives

- To describe the current structure of Nepalese higher education using official enrollment and institutional data.
- To compare the selected universities in terms of enrollment size, gender composition and institutional concentration.
- To calculate selected ratios, shares, growth measures and inequality indicators relevant to higher education.
- To identify major challenges related to access, equity, quality, capacity, research, finance, infrastructure and governance.
- To develop a transparent mathematical framework for a future higher-education performance and challenge index.
- To propose evidence-based policy measures differentiated by institutional type and scale.

Research Questions

• What is the present quantitative structure of higher education in Nepal?

• How concentrated is enrollment among the selected universities?

• What differences exist in male and female enrollment across the selected institutions?

• Which structural challenges are most visible when higher education is examined using ratios and comparative indicators?

• How can multiple dimensions of higher education status be combined mathematically without creating a misleading ranking?

Working Propositions

• Enrollment in Nepalese higher education is highly concentrated in a small number of universities.

• Gender participation has improved substantially, but institutional patterns remain heterogeneous.

• Institutional scale, geographic reach and resource capacity create different categories of higher-education challenges.

• A multidimensional index provides a more informative picture than a single enrollment indicator.

Review of Literature and Policy Context

The literature on higher education consistently treats access, quality, equity, financing, research and governance as interconnected dimensions. Human-capital theory views education as an investment that increases productive capacity. Tinto's work on student persistence emphasizes academic and social integration, while Astin's involvement theory highlights the role of student engagement. The World Bank's work on tertiary education in developing countries emphasizes the importance of quality, relevance, financing and institutional governance. UNESCO's education monitoring work similarly treats access and equity as necessary but insufficient conditions for meaningful educational outcomes.

In Nepal, UGC reports provide the principal statistical foundation for national higher-education analysis. The 2023/24 EMIS report covers institutions, enrollment, gender parity, pass rates, graduates, teachers, student-teacher ratios, financing and trends. The report states that UGC established EMIS with support from the World Bank to standardize higher-education data collection and publication. This institutional data infrastructure is important because mathematical analysis depends on consistent definitions and denominators.

Previous Nepalese research has examined specific issues such as student enrollment trends, attendance, teaching practices, digital access, social-media use, academic performance and online learning. These studies indicate that Nepalese higher education should not be analyzed through one indicator alone. However, many studies remain institution-specific or programme-specific. This paper therefore complements them with a system-level comparative framework.

Policy Context

Nepal's higher-education governance involves the Ministry of Education, Science and Technology, UGC, universities, professional councils and individual campuses. The expansion of provincial universities represents an attempt to decentralize higher education, while affiliated colleges have expanded access without requiring every institution to be directly operated by a university. This mixed structure increases access but also makes quality

assurance, credit transfer, curriculum consistency, teacher standards and data comparability more complex.

Conceptual Dimensions Used in This Study

Dimension	Meaning	Representative indicators
Access	Ability to enter and participate in higher education	Enrollment, GER, geographic distribution
Equity	Fair participation across gender and social/geographic groups	Female share, GPI, regional distribution
Capacity	Ability of institutions to support students	Teachers, STR, infrastructure, finance
Quality	Effectiveness and relevance of learning	Pass rates, completion, accreditation, pedagogy
Research	Ability to generate and apply knowledge	Research funding, publications, postgraduate/PhD activity
Governance	Effectiveness and responsiveness of management	Academic calendar, examination systems, QA, autonomy

Methodology and Mathematical Framework

Research Design

The paper follows a quantitative secondary-data case-study design. The primary statistical source is the UGC Higher Education EMIS Report 2023/24, supplemented by official statistical and policy sources and established academic literature. Seven universities are selected to represent different sizes and geographic/institutional profiles: TU, PU, PoKU, KU, FWU, MU and RJU. The selection is purposive rather than statistically representative; it is intended to illustrate variation within the national system.

Data and Variables

The principal variables are total enrollment, male enrollment, female enrollment and institutional share of national enrollment. Derived variables include female participation rate, male participation rate, gender ratio, enrollment share, cumulative concentration and normalized scores. Where official data are not sufficient to calculate an indicator, the paper proposes the formula rather than inventing a value.

Mathematical Measures

Enrollment share is calculated as $S_i = E_i / E_t \times 100$, where E_i is enrollment of university i and E_t is total higher-education enrollment. Female participation is $F_i = \text{Female}_i / E_i \times 100$. The gender ratio is $G_i = \text{Female}_i / \text{Male}_i$. A simple concentration ratio for the top

k institutions is $CR_k = \Sigma S_i$ for the k largest institutions. A normalized indicator can be expressed as $N_i = (x_i - x_min)/(x_max - x_min) \times 100$ for a positive indicator; for a negative indicator the transformation is reversed.

For a composite index, dimensions can be weighted: $HPI = \Sigma w_j I_j$, where I_j is the normalized dimension score and $\Sigma w_j = 1$. If the purpose is to measure challenges rather than performance, the index can be reversed: $CI = 100 - HPI$. Weighting should be established through expert consultation, sensitivity analysis or a transparent equal-weight baseline rather than chosen to produce a preferred ranking.

Reliability and Interpretation

The study does not infer causality from descriptive statistics. Enrollment share does not measure educational quality, and a large university is not necessarily weaker or stronger than a small university. Likewise, gender balance is not a direct measure of learning outcomes. The mathematical analysis is therefore used to identify structural patterns and formulate hypotheses for future primary research.

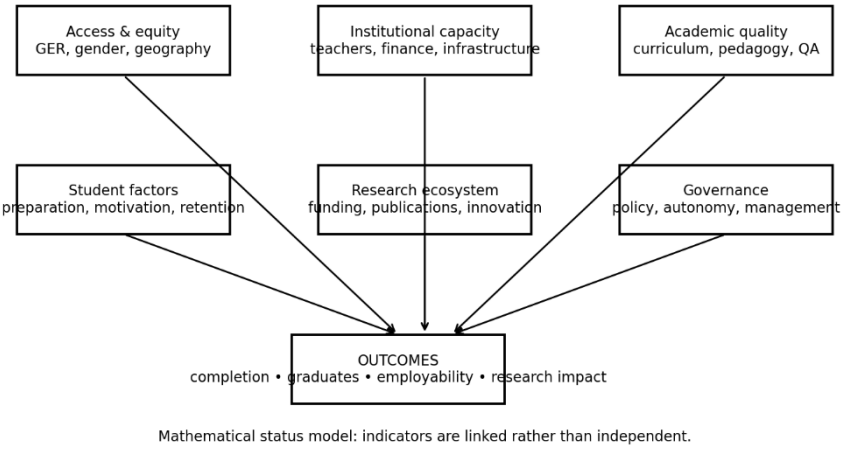


Figure 1. Multidimensional analytical framework for Nepalese higher education.

Present Status of Higher Education in Nepal

Institutional Expansion

According to the UGC Higher Education EMIS Report 2023/24, Nepal had 24 universities and medical academies in the reporting structure, comprising 17 full universities and seven medical academies. The report records 1,432 campuses and 633,053 students. The

number of institutions alone, however, does not reveal the distribution of students or resources among them.

Enrollment Status

The national enrollment structure is dominated by TU. The official UGC table reports 491,299 TU students, followed by PU with 39,780, PoKU with 35,200, KU with 21,053, FWU with 19,356 and MU with 11,171. RJU has 527 students. The contrast between TU and newer universities is therefore extremely large.

University	Enrollment	National share (%)	Male	Female	Female share (%)
Tribhuvan University	491299	77.61	204449	286850	58.39
Purbanchal University	39780	6.28	19102	20678	51.98
Pokhara University	35200	5.56	19560	15640	44.43
Kathmandu University	21053	3.33	11148	9905	47.05
Far Western University	19356	3.06	6530	12826	66.26
Mid-West University	11171	1.76	4736	6435	57.6
Rajarshi Janak University	527	0.08	240	287	54.46

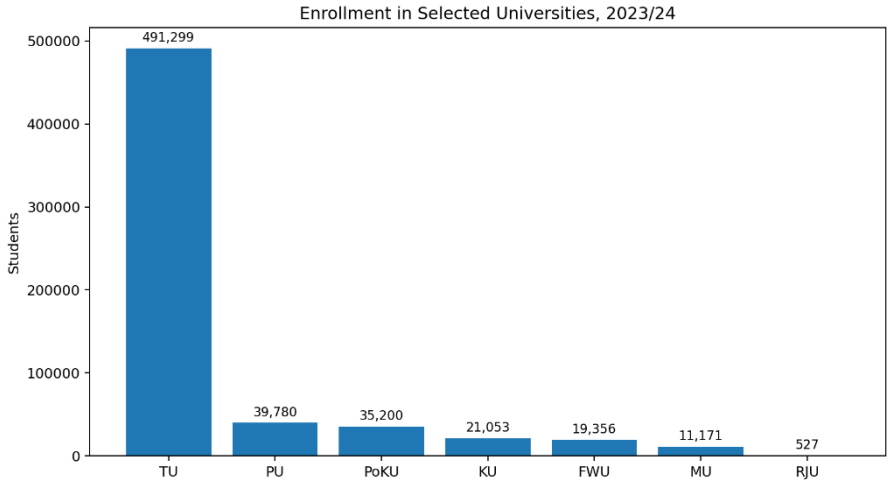


Figure 2. Enrollment in the seven selected universities, 2023/24.

Gender Composition

The national UGC total contains 274,913 male and 358,140 female students. Thus, females constitute approximately 56.57 percent of total enrollment, while males constitute approximately 43.43 percent. Among the selected universities, female participation is highest in FWU (about 66.27 percent) and lowest in PoKU (about 44.43 percent). TU's female share is approximately 58.40 percent.

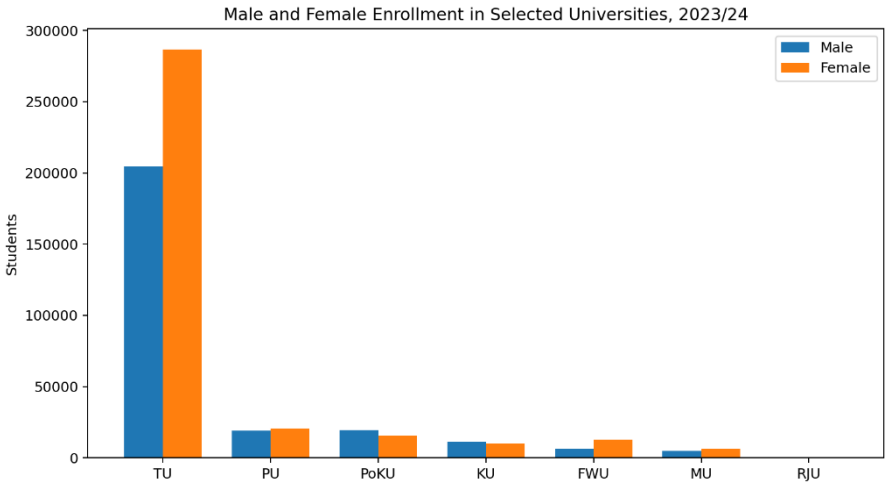


Figure 3. Male and female enrollment in the selected universities.

Geographic Distribution

The UGC report indicates that 58.94 percent of campuses are located in the Hill region, 36.10 percent in the Tarai and 4.96 percent in the Mountain region. Province-level distribution is also uneven: Bagmati accounts for 43.58 percent of campuses, while Madhesh accounts for 8.59 percent. These figures suggest that physical institutional access remains more concentrated than a national count of universities might imply.

Institutional Diversity

The current system combines very large multi-campus universities, specialized universities, regional universities, open education, provincial universities and medical academies. This diversity is valuable, but the same performance indicator cannot necessarily be interpreted identically across all institutional types. A university with hundreds of thousands of students faces a fundamentally different administrative problem from an emerging specialized university with several hundred students.

Case Study of Selected Universities

Tribhuvan University

TU is the dominant institution in Nepalese higher education. The UGC report describes it as Nepal's first and largest university, established in 1959. In 2023/24 it had 491,299 students and 1,115 campuses, including 62 constituent and 1,053 affiliated campuses. Its 77.61 percent enrollment share makes TU effectively a system within the

system. The mathematical implication is high concentration risk: improvements or weaknesses in TU have a large effect on national aggregate indicators.

Purbanchal University

PU enrolls 39,780 students, or 6.28 percent of the national total. Its scale is substantially smaller than TU but large enough to play a major role in national access. Its female enrollment slightly exceeds male enrollment, indicating a female share above 50 percent.

Pokhara University

PoKU has 35,200 students and a 5.56 percent national share. Unlike several selected institutions, its male enrollment exceeds female enrollment. This illustrates why national gender averages should not be assumed to describe every university.

Kathmandu University

KU has 21,053 students and a 3.33 percent national share. Its institutional scale is much smaller than TU's, while its student distribution is comparatively concentrated in constituent and private affiliated provision. The case demonstrates that institutional size and organizational structure should be analyzed together.

Far Western University

FWU has 19,356 students and a 3.06 percent share. Its female enrollment is substantially larger than male enrollment. Its position in the Far Western region makes it particularly relevant to the question of geographic decentralization and regional access.

Mid-West University

MU has 11,171 students and a 1.76 percent national share. Like FWU, it is important for regional access and the decentralization of higher education. Its relatively small national share also illustrates the scale gap between established and newer institutions.

Rajarshi Janak University

RJU is a relatively new university and, in 2023/24, reports 527 students, or 0.08 percent of national enrollment. Female enrollment is 287 compared with 240 male students. Because of its small base, percentage changes can be large from year to year; therefore, raw counts and growth rates should be interpreted together. RJU also illustrates the policy

challenge of developing new universities without simply reproducing existing institutional constraints.

Mathematical Analysis of Key Indicators

Enrollment Concentration

Using the official national total of 633,053, TU's share is 491,299/633,053 × 100 = 77.61 percent. The combined share of TU, PU and PoKU is approximately 89.45 percent. Adding KU gives approximately 92.78 percent. Thus, four universities account for more than nine-tenths of enrollment among the central-university group represented in the selected data.

Concentration measure	Formula	Result
CR1	TU / national total	77.61%
CR3	TU+PU+PoKU / national total	89.45%
CR4	TU+PU+PoKU+KU / national total	92.78%
CR7	Seven selected universities / national total	97.68%

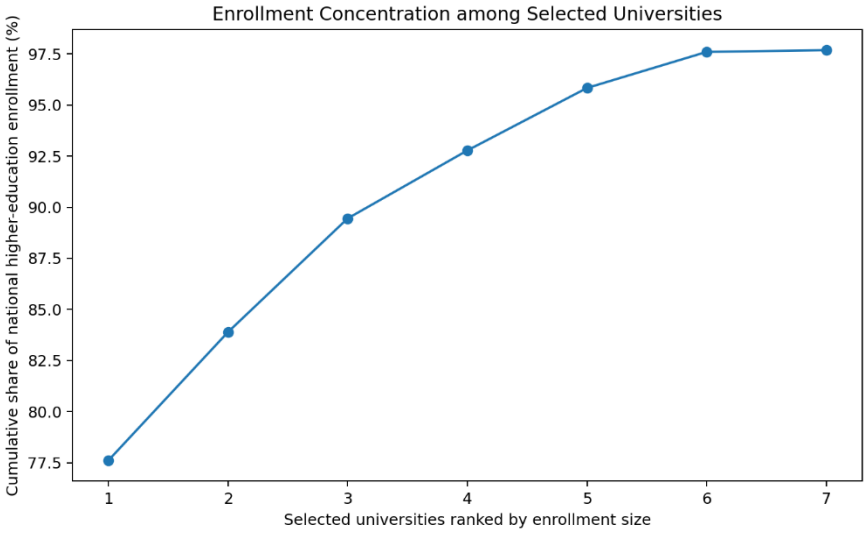


Figure 4. Cumulative enrollment concentration among selected universities

Female Participation

University	Female students	Female share	Female/Male ratio
TU	286,850	58.39%	1.40
PU	20,678	51.98%	1.08
PoKU	15,640	44.43%	0.80
KU	9,905	47.05%	0.89
FWU	12,826	66.26%	1.96
MU	6,435	57.60%	1.36
RJU	287	54.46%	1.20

A female-to-male ratio greater than 1 indicates more female than male students. The ratio is highest for FWU and remains above 1 for TU, PU, MU and RJU. PoKU and KU have ratios below 1. The national female majority should therefore be interpreted as a broad system trend rather than evidence of uniform gender balance across universities or disciplines.

Size Ratio

The scale ratio between TU and RJU is 491,299 / 527 ≈ 932. In other words, TU's reported enrollment is roughly 932 times that of RJU in 2023/24. This extreme ratio demonstrates why a common administrative strategy cannot be applied uniformly across universities.

Herfindahl-Type Enrollment Concentration

A simple Herfindahl-type concentration measure calculated over the seven selected universities is $HHI_7 = \Sigma S_i^2$, where S_i is each university's national enrollment share in percentage points. Using the selected shares, $HHI_7 \approx 6116.9$ percentage-point-squared. This is not a conventional market-competition ranking because the remaining universities are excluded; its purpose is to quantify how heavily the selected group is dominated by TU.

Gender Parity Index

For a university-level gender parity ratio, GPI = Female enrollment / Male enrollment. A value of 1 indicates numerical parity, values above 1 indicate female majority and values below 1 indicate male majority. This indicator is simple but should be supplemented by programme-level and regional analysis because aggregate parity can conceal subject-specific disparities.

Enrollment Growth Formula

For longitudinal data, the annual growth rate should be calculated as $g = (E_t - E_{t-1})/E_{t-1} \times 100$. When a longer period is available, the compound annual growth rate is $CAGR = (E_t/E_0)^{(1/n)} - 1$. These measures should be calculated separately for total enrollment, female enrollment and graduates because enrollment growth without graduation growth can signal progression problems.

Illustrative Challenge Index

A multidimensional index can reduce the temptation to treat enrollment as the sole measure of system health. Suppose six dimensions—access, equity, capacity, quality, research and governance—are each normalized to 0–100. An illustrative index can be formed with equal weights of 1/6. The scores below are deliberately hypothetical and demonstrate the calculation method only; they are not an official assessment of Nepalese universities.

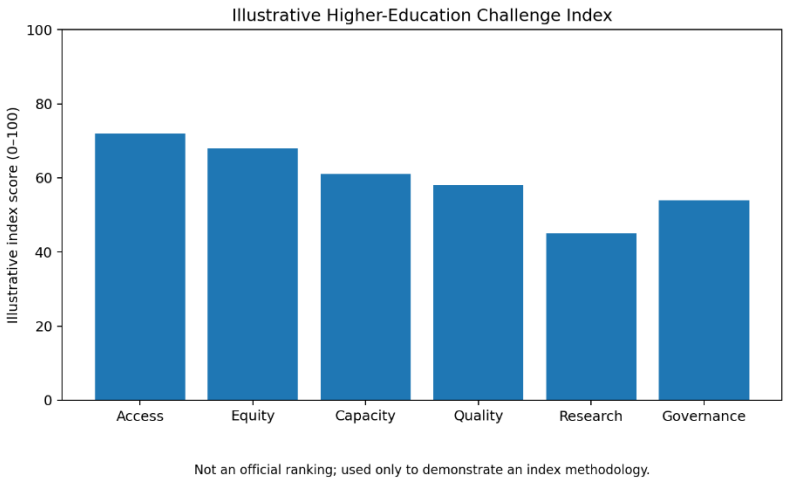


Figure 5. Illustrative challenge-index methodology; scores are hypothetical, not official university ratings.

Major Challenges

Quality Versus Expansion

The first challenge is converting expanded access into meaningful learning. A university can enroll many students while facing shortages of teachers, laboratories, library materials, academic advising and timely assessment. Quality must therefore be evaluated using outcomes and learning processes, not only institutional counts.

Extreme Institutional Concentration

The 77.61 percent share of TU is the clearest mathematical signal in the data. Concentration can create economies of scale, but it also increases systemic vulnerability. Examination delays, administrative bottlenecks, resource constraints or weak coordination at TU can affect national-level performance indicators disproportionately.

Geographic Inequality

The concentration of campuses in particular ecological belts and provinces raises questions about equitable access. Geographic access depends not simply on whether a university exists but on whether students can reach suitable programmes at reasonable cost. Digital education can reduce some geographic barriers, but only where connectivity, devices, digital literacy and institutional support are adequate.

Financing and Resource Allocation

Public financing must balance access, quality, research and infrastructure. A purely enrollment-based allocation may reward large institutions without correcting structural disadvantages. Conversely, equal funding per university can over-support small institutions relative to their student populations. A mixed formula using base funding, enrollment, research performance, equity indicators and quality outcomes is mathematically more defensible.

Teacher Capacity and Student-Teacher Ratio

Teacher availability influences course delivery, assessment feedback, research supervision and student support. Student-teacher ratio should be interpreted by discipline because laboratory sciences, engineering and clinical programmes require different staffing levels from lecture-based subjects. Future analysis should therefore calculate STR by programme cluster rather than relying only on a university-wide average.

Research and Innovation

Nepal's universities face the challenge of moving from teaching-dominant institutions toward stronger research ecosystems. Research requires competitive funding, laboratories, data access, research administration, doctoral supervision, publication support and collaboration with industry and government. The number of universities alone does not guarantee research capacity.

Employability and Curriculum Relevance

Graduate employability depends on curriculum relevance, practical skills, internships, communication, digital competence and labour-market alignment. Higher education should therefore be evaluated partly through graduate destinations and employer feedback. A mathematical dashboard could compare graduate employment, further study and entrepreneurship rates by programme.

Governance and Academic Administration

Academic calendars, examinations, results, procurement, recruitment and quality assurance are governance functions with direct effects on student experience. Large institutions face greater coordination costs. Digital student-information systems and transparent performance dashboards can reduce administrative friction, but technology should be accompanied by process redesign.

Digital Divide

Digital technology can expand access to journals, learning platforms and communication, but unequal connectivity creates a new layer of educational inequality. The appropriate measure is not simply internet availability; it should include reliability, affordability, device ownership, academic-use intensity and digital skills.

Student Retention and Completion

Enrollment is an input, not an outcome. Universities should monitor progression from admission to completion. A completion ratio can be defined as C = graduates / relevant entering cohort, while a pass rate can be defined as P = students passing / students appearing × 100. Cohort-based measures are preferable because annual graduates can be affected by cohort size and delayed completion.

Discussion

The mathematical analysis produces a clear picture of structural duality. Nepal has a large and increasingly diverse higher-education system, but that system is heavily concentrated in a few institutions. TU's dominance provides nationwide reach through a very large affiliated network, yet it also makes institutional reform at TU disproportionately important for national outcomes. Smaller universities, meanwhile, have an opportunity to

specialize, decentralize access and experiment with more responsive academic systems, but they face their own capacity constraints.

The gender analysis is encouraging in one respect: female students constitute a majority nationally and in several selected universities. Yet gender parity should not be equated with complete educational equity. Programme choice, completion, employment, leadership and research participation may show different patterns. A strong national study should therefore move from enrollment parity to outcome parity.

The study also demonstrates why simple rankings are inappropriate. A university with 20,000 students cannot be judged by the same administrative metric as a university with 500 students. Instead, institutions should be compared against appropriate peer groups and against their own historical trajectories. Mathematical analysis is most useful when it reveals relationships and trade-offs rather than producing a single number without context.

Implications for Emerging Universities

Emerging universities should avoid uncontrolled expansion before establishing stable academic systems. A staged model—limited programmes, strong faculty, adequate infrastructure, research niches, digital administration and transparent quality assurance—can reduce the risk of creating many programmes without sufficient depth.

Implications for Large Universities

Large universities need decentralization within the institution. Campus-level academic management, integrated digital records, standardized quality assurance, delegated authority and transparent performance indicators can reduce coordination costs. The objective is not simply to reduce enrollment but to make scale manageable.

Policy Recommendations

Build a National Higher-Education Data Architecture

UGC, universities and relevant government agencies should maintain harmonized definitions for enrollment, graduates, pass rates, teachers, research outputs, finance and completion. Each indicator should specify its denominator and reporting year. Open, machine-readable data would substantially improve independent analysis.

Use a Multi-Dimensional Funding Formula

Funding should combine a base allocation with variables such as enrollment, discipline cost, geographic disadvantage, equity, research performance and quality outcomes. A formula can be written $F_i = \alpha B_i + \beta E_i + \gamma R_i + \delta Q_i + \varepsilon D_i$, with weights determined through consultation and sensitivity testing.

Reform Large-System Administration

For TU and other high-enrollment systems, administrative decentralization, digital examination systems, integrated student records and campus-level accountability should be prioritized. The goal is to reduce the transaction costs generated by very large student populations.

Strengthen Regional Universities

Regional universities should receive targeted support in faculty recruitment, laboratories, libraries, digital infrastructure and research partnerships. Their role should not be to imitate TU but to provide high-quality regional and specialized education.

Improve Quality Assurance

Accreditation and internal quality assurance should connect directly to student learning, curriculum relevance, faculty development and graduate outcomes. Quality assurance should be continuous rather than an occasional compliance exercise.

Strengthen Research

Competitive research grants, doctoral supervision, research offices, publication support and university-industry-government partnerships should be expanded. Research funding should reward collaboration and societal relevance as well as publication volume.

Support Student Success

Universities should develop early-warning systems based on attendance, assessment completion, course performance and student support needs. Academic advising and remedial instruction can be targeted to students who show early signs of difficulty.

Promote Gender and Social Equity

The national female enrollment majority is a positive access indicator, but policies should examine completion, discipline choice, employment and leadership outcomes.

Scholarships and targeted support should be directed toward groups facing financial, geographic or social barriers.

Integrate Digital Learning Responsibly

Digital learning should be treated as an institutional capability, not simply a technology purchase. Universities need reliable connectivity, learning-management systems, digital libraries, teacher training, student digital-literacy support and mechanisms for academic integrity.

Adopt Peer-Group Benchmarking

Universities should be grouped by size and mission before performance comparison. Large comprehensive universities, regional universities, specialized universities and open universities should have partly different benchmark indicators.

Proposed Higher-Education Performance and Challenge Index

To make future monitoring more systematic, this paper proposes a Higher-Education Performance Index (HPI) with six dimensions. The index is a methodological proposal, not an official Nepalese ranking. Its value lies in making assumptions explicit and allowing the weights and indicators to be revised through expert consultation.

Dimension	Example sub-indicators	Illustrative weight
Access	Enrollment, GER, regional reach	0.15
Equity	Female participation, disadvantaged-group participation	0.15
Capacity	STR, infrastructure, finance/student	0.20
Quality	Pass rate, completion, accreditation, learning measures	0.20
Research	Research funding, publications, postgraduate activity	0.15
Governance	Academic calendar, results timeliness, QA, digital systems	0.15

Normalization

For a positive indicator x, normalized score is $N = 100(x - x_{min})/(x_{max} - x_{min})$. For a negative indicator such as student-teacher ratio where lower values are preferred, $N = 100(x_{max} - x)/(x_{max} - x_{min})$. For indicators with a target rather than a simple maximum, a target-distance function can be used. Normalization should be calculated within a clearly defined peer group to avoid comparing fundamentally different institutions.

Weighted Index

The overall score is HPI = 0.15A + 0.15E + 0.20C + 0.20Q + 0.15R + 0.15G. The challenge index can then be CI = 100 − HPI. Sensitivity analysis should be conducted by changing weights, for example to equal weights, and checking whether conclusions remain stable.

Why an Index Must Not Become a Ranking

A composite number can hide important weaknesses. Two universities can have identical overall scores while having very different profiles. Therefore, the index should always be accompanied by a dashboard showing each dimension separately. Decision-makers should use the index to identify areas for improvement, not to create a simplistic league table.

Suggested Dashboard

Indicator	Formula	Policy question
Enrollment share	$E_i/E_t \times 100$	Where is the student load concentrated?
Female share	$F_i/E_i \times 100$	Is access gender-balanced?
GPI	F_i/M_i	How close is numerical parity?
STR	Students/teachers	Is staffing adequate for the discipline?
Pass rate	Pass/appeared ×100	Are students progressing?
Completion rate	Graduates/cohort ×100	Are students finishing?
Research intensity	Research expenditure/student	Is teaching complemented by research?
Funding/student	Total funding/enrollment	How resource-intensive is provision?

Limitations

The main limitation is data availability. The UGC report provides strong system-level statistics, but a complete mathematical assessment of quality would require standardized university-level data on teaching quality, learning outcomes, research expenditure, completion, graduate employment and infrastructure. The selected-university case study is purposive and should not be interpreted as a statistically representative sample.

The analysis also uses 2023/24 enrollment as the primary comparison year. Enrollment is an important indicator of access but does not measure educational quality by itself. Some institutional differences may reflect mission, programme mix or affiliation structure rather than performance. Finally, the illustrative challenge-index scores are methodological examples and must not be cited as empirical measurements.

Future Research

• Construct a 10-year panel dataset for all Nepalese universities.

• Estimate enrollment and graduate growth using CAGR and cohort-based completion measures.

• Calculate student-teacher ratios by discipline and institution type.

• Measure research intensity using expenditure, publications, citations, patents and postgraduate output.

• Use multilevel regression to examine how institutional characteristics influence student outcomes.

• Develop a public national higher-education dashboard with reproducible formulas.

Conclusion

Nepalese higher education is simultaneously a story of expansion and imbalance. The system now contains a broad range of universities and academies, and more than 633,000 students were enrolled in 2023/24 according to the UGC EMIS report. Yet the mathematical structure is highly concentrated: TU alone accounts for 77.61 percent of enrollment, while the selected universities collectively represent the overwhelming majority of the system. Female participation is strong at the national level and exceeds male participation in several major universities, although institutional differences remain.

The central challenge is therefore to move from expansion to consolidation. Nepal needs stronger quality assurance, better academic administration, more equitable geographic access, improved research capacity, reliable digital systems, differentiated financing and systematic monitoring of student progression. Mathematical indicators can help policymakers see these problems clearly, but numbers must be interpreted within institutional and social context.

A sustainable higher-education system should not be defined by the number of universities alone. It should be judged by how effectively institutions transform resources and access into learning, completion, research, innovation, employment and social opportunity. The framework presented in this paper offers a practical starting point for that

transition from counting institutions to measuring performance and challenges in a transparent, multidimensional manner.

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