

Mathematical Analysis of the Present Status and Challenges of Higher Education in Nepal: A Case Study of University

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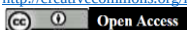
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ABSTRACT

This paper examines the present status and major challenges of higher education in Nepal through a quantitative, secondary-data case study of four universities: Tribhuvan University, Purbanchal University, Pokhara University, and Kathmandu University. The analysis combines descriptive statistics, ratios, concentration measures, growth rates, gender-parity calculations, and comparative indicators. The latest University Grants Commission (UGC) Education Management Information System data available for the 2023/24 academic year show 633,053 students in Nepal's higher education institutions, including 358,140 female and 274,913 male students. The resulting female enrollment share is 56.57% and the female-to-male gender parity ratio is 1.30. The same dataset reports 28,073 students in foreign-university-affiliated campuses in Nepal, bringing the combined figure to 661,126. At the national level, the higher-education gross enrollment ratio calculated by UGC using the 18–22 age group is about 22%. The selected universities account for {top4_share:.2f}% of domestic higher-education enrollment, demonstrating a strong concentration of students in a small number of institutions. Bachelor's programs represent 89.62% of reported university enrollment, while MPhil and PhD enrollment together account for less than one-half of one percent. This structure reveals a system that has expanded access but remains uneven in postgraduate depth, research intensity, institutional capacity, and labor-market relevance. Public financing to universities and boards increased from NPR 9.30 billion in 2017/18 to NPR 17.457 billion in 2023/24, yet funding growth has not eliminated disparities in student–teacher ratios, infrastructure, quality assurance, or research capacity. The paper argues that Nepal's next stage of higher-education reform should move from expansion alone toward differentiated institutional missions, stronger quality assurance, research-linked financing, digital transformation, academic autonomy with accountability, and systematic university–industry collaboration.

Introduction

Recent studies by Sahani and collaborators have demonstrated the increasing importance of integrating mathematical modelling, numerical techniques, and artificial intelligence for solving complex decision-making and risk-management problems. Sahani et al. (2026) developed a machine learning–augmented hybrid risk management framework that combines fractional stochastic modelling, Wasserstein robustness, and rough-path neural filtering to address deep uncertainty in Nepalese management systems. The study highlights how advanced computational approaches can improve risk

prediction and enhance decision-making under uncertain conditions. Their framework contributes to the growing field of intelligent management systems by connecting stochastic mathematics with machine learning-based predictive analysis.

Similarly, Sahani et al. (2026) proposed hybrid analytical, numerical, and machine learning frameworks for solving deterministic and stochastic differential equations. The research emphasized stability analysis, convergence assessment, and uncertainty quantification as essential components for reliable computational modelling. By combining traditional mathematical approaches with machine learning techniques, the study provides a more flexible framework for analyzing complex dynamic systems where conventional numerical methods may face limitations. In the financial sector, Sahani et al. (2026) explored explainable machine learning applications for credit risk management and intelligent lending decisions in Nepalese cooperative banks. The study emphasized the importance of interpretable artificial intelligence models for improving transparency, reliability, and risk assessment in financial decision-making. The authors argued that explainable machine learning can support institutions by identifying hidden patterns in financial data while maintaining accountability in automated decisions. Extending the application of hybrid computational frameworks, Sahani et al. (2026) investigated risk-aware decision-making and uncertainty quantification in dental practice management systems. Their research introduced hybrid analytical–numerical–machine learning architectures to improve operational stability, resource allocation, and strategic planning. The study demonstrates that advanced computational models are not limited to engineering or finance but can also support healthcare management systems. Furthermore, Sahani et al. (2026) examined the role of biotechnological catalysts within hybrid analytical, numerical, and machine learning architectures for management systems. Their work focused on improving risk-aware decision-making and uncertainty evaluation through integrated computational approaches. This research illustrates the broader potential of artificial intelligence-driven frameworks in multidisciplinary environments where biological, technological, and managerial factors interact. Sahani et al. (2026) also developed a hybrid framework for health management, resource allocation, operational efficiency, risk forecasting, and strategic decision-making in Nepal. The study demonstrated how combining mathematical modelling with machine learning can improve planning and forecasting capabilities in complex healthcare systems. The findings suggest that data-driven approaches can assist policymakers and organizations in optimizing limited resources and improving service delivery. Earlier research by Sahani (2024) examined big data learning analytics and optimization algorithms, focusing on their applications, challenges, and future opportunities. The study highlighted that large-scale data analysis combined with optimization methods can support improved decision-making across multiple domains. Similarly, Sahani (2024) applied artificial intelligence-enhanced finite element methods (FEM) for structural analysis, demonstrating how machine learning can improve computational efficiency and accuracy in engineering simulations.

Sahani (2023) investigated the application of numerical methods in structural health monitoring using Internet of Things (IoT) sensors. The study emphasized the importance of combining sensor-based data collection with numerical modelling for real-time monitoring and predictive maintenance. This approach provides a foundation for intelligent infrastructure management by enabling early detection of structural problems. Sahani et al. (2022) examined the prediction of numerical integration errors using machine learning approaches. Their research showed that machine learning techniques can improve the reliability of numerical computations by identifying and predicting possible errors. This contribution is significant because accurate numerical solutions are essential for scientific modelling and engineering applications. In another study, Sahani (2023) developed neural network surrogate models for weather prediction using numerical solutions of shallow water equations. The research demonstrated how neural networks can complement traditional mathematical models by reducing computational complexity while

maintaining predictive performance. This approach represents an important development in combining physics-based modelling with artificial intelligence. Finally, Sahani and Sah (2024) investigated the integration of neural networks with numerical methods for solving nonlinear differential equations. Their study highlighted the potential of hybrid mathematical–machine learning approaches to overcome limitations associated with conventional numerical techniques. The integration of artificial intelligence with established mathematical methods provides a promising pathway for solving increasingly complex nonlinear systems. Overall, the reviewed literature demonstrates a consistent methodological progression from traditional numerical modelling toward integrated analytical–numerical–machine learning frameworks. Sahani’s research contributions collectively show that artificial intelligence, uncertainty quantification, and mathematical optimization can provide powerful tools for improving prediction, risk management, resource allocation, and decision-making across diverse fields, including finance, healthcare, engineering, and organizational systems.

Higher education is increasingly important to Nepal's economic transformation because the country must develop human capital capable of supporting digital services, science and technology, entrepreneurship, public administration, health, education, and internationally competitive production. The World Bank describes tertiary education as a major contributor to skills, productivity, innovation, employability, and resilience. In Nepal, however, the expansion of access has occurred alongside persistent questions about institutional quality, governance, financing, research productivity, employability, and the ability of domestic universities to retain students.

The institutional landscape has also become more complex. The UGC's 2023/24 report identifies 24 universities and medical academies, including 17 full universities and seven medical academies. The system contains a large and historically dominant Tribhuvan University, newer public and provincial universities, specialized universities, open and technical institutions, and a large network of affiliated campuses. This diversity creates opportunities for regional access but also produces major differences in institutional scale, resources, faculty availability, and academic mission.

This paper adopts a mathematical perspective because many of the central problems of higher education can be expressed as measurable relationships. Enrollment concentration can be measured as a share of total enrollment; gender equity can be represented through the gender parity index; faculty capacity can be assessed through student–teacher ratios; financing pressure can be examined through funding growth relative to enrollment; and postgraduate depth can be expressed as the share of students in master's and research degrees. Such measures do not replace qualitative judgment, but they make structural patterns visible and comparable.

Analytical framework for mathematical assessment of higher education

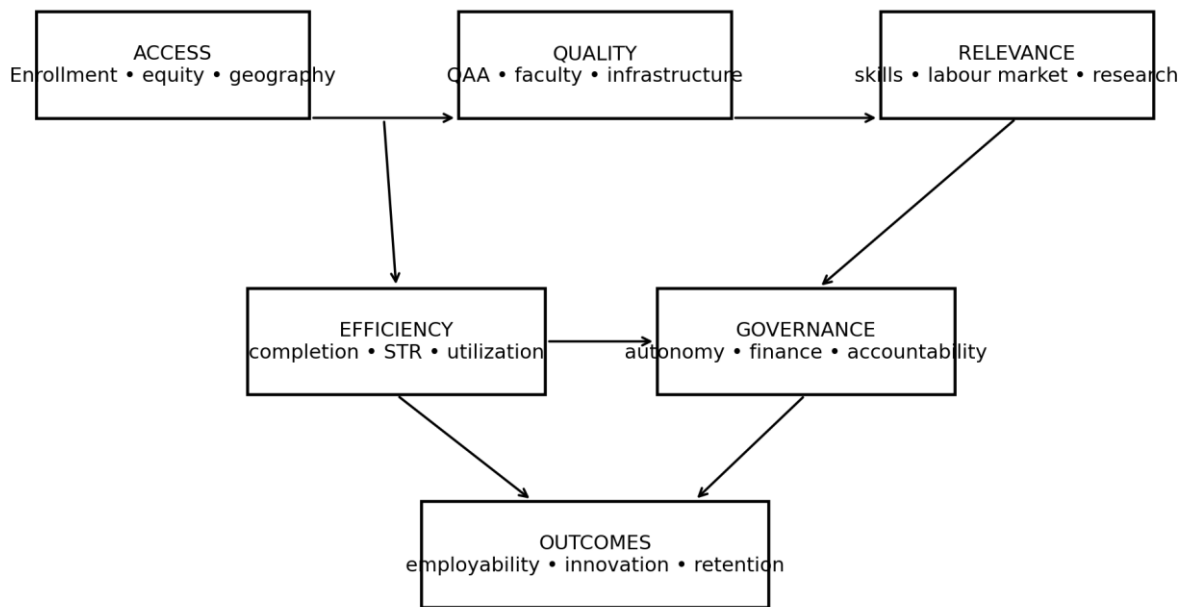


Figure 1. Analytical framework used in the study.

The central proposition is that Nepal's higher-education challenge is not simply a shortage of seats. It is a problem of conversion: the system must convert growing participation and public investment into learning quality, research, employability, innovation, and equitable opportunity. A university can increase enrollment while simultaneously experiencing deterioration in student–teacher ratios, research intensity, infrastructure utilization, or completion efficiency. Mathematical analysis is therefore useful for identifying where expansion is translating into capacity and where it is producing pressure.

Objectives of the Study

The general objective is to analyze the present status and challenges of higher education in Nepal using quantitative indicators, with a focused comparison of selected universities.

Specific objectives are to:

- measure the scale and structure of higher-education enrollment in Nepal;
- calculate gender composition and gender parity from national enrollment data;
- measure enrollment concentration among selected universities;
- compare academic-level composition and postgraduate/research depth;
- examine faculty distribution and student–teacher ratios as indicators of instructional capacity;
- assess the growth of public financing and discuss its relationship with institutional demand;
- identify the main structural challenges affecting quality, relevance, governance, research, digital learning, and student retention; and
- propose mathematically informed policy indicators and reform priorities.

Research Questions

1. What is the current quantitative structure of higher education in Nepal?
2. How concentrated is higher-education enrollment among major universities?
3. What do gender-parity and academic-level indicators reveal about access and progression?
4. How do selected universities differ in scale, disciplinary composition, and capacity?
5. What are the principal measurable constraints related to faculty, financing, quality assurance, research, and relevance?

6. What policy indicators could help Nepal shift from enrollment expansion to quality- and outcome-oriented higher-education development?

Methodology

This study uses a descriptive-analytical research design based primarily on secondary data. The principal quantitative source is the University Grants Commission's Education Management Information System (EMIS) Report for 2023/24, supplemented by UGC strategic and quality-assurance documents, the Ministry of Education, Science and Technology, World Bank materials, UNESCO/World Bank education indicators, and peer-reviewed or scholarly discussions of Nepalese higher education.

The case-study component focuses on four institutions with different historical and organizational profiles: Tribhuvan University (the dominant national university), Purbanchal University (a large affiliating university), Pokhara University (a major public university with strong management and technical programs), and Kathmandu University (a smaller research-oriented university with a strong professional and science/technology profile). The comparison is not intended to rank universities absolutely. Rather, it illustrates how institutional size and academic composition affect system-level performance.

The mathematical indicators used are:

- Enrollment share: $S_i = E_i / E_{total} \times 100$.
- Gender parity index (GPI): $GPI = \text{Female enrollment} / \text{Male enrollment}$.
- Foreign-affiliated share: $FAS = \text{Foreign-affiliated enrollment} / \text{Total enrollment including foreign-affiliated} \times 100$.
- Enrollment concentration of selected universities: $C_4 = \Sigma E_{selected} / E_{total} \times 100$.
- Student–teacher ratio: $STR = \text{Students} / \text{Teachers}$.
- Level share: $L_s = \text{Enrollment at level} / \text{Total enrollment} \times 100$.
- Compound annual growth rate: $CAGR = (V_t / V_0)^{(1/n)} - 1$.
- Funding per student (illustrative system indicator): $FPS = \text{Public funding} / \text{domestic higher-education enrollment}$.
- Postgraduate depth: $PGD = (\text{Master} + \text{MPhil} + \text{PhD enrollment}) / \text{total university enrollment} \times 100$.

Because the data are aggregated, the paper does not claim causal relationships. Ratios are interpreted as diagnostic indicators. For example, a high student–teacher ratio signals potential pressure on teaching resources, but it does not by itself prove low learning quality. Similarly, enrollment concentration may reflect institutional mission and affiliation structures rather than inefficiency. These limitations are explicitly considered in the discussion.

Present Status of Higher Education in Nepal

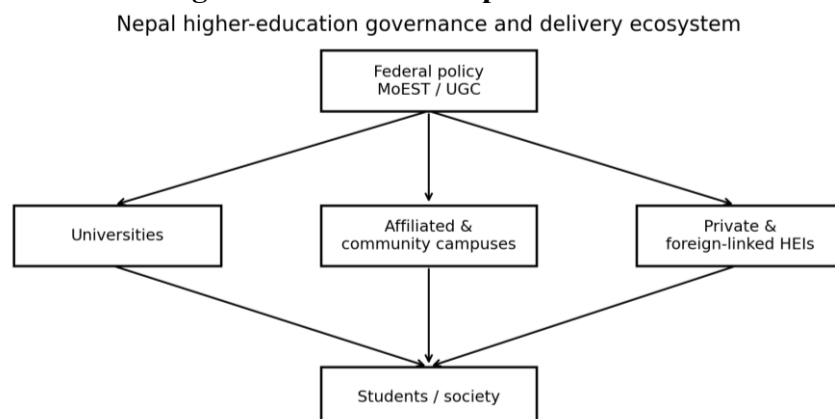


Figure 2. Simplified higher-education governance and delivery ecosystem in Nepal.

Nepal's higher-education system has expanded considerably in institutional count and participation. The UGC 2023/24 report records 24 universities and medical academies, with 17 full universities and seven medical academies. The system's historical center of gravity remains Tribhuvan University, but the emergence of Kathmandu University, Pokhara University, Purbanchal University, regional universities, technical institutions, open university arrangements, and medical academies has created a more diversified landscape.

The latest UGC data show 633,053 students in higher education institutions, of whom 358,140 are female and 274,913 are male. An additional 28,073 students are enrolled in foreign-university-affiliated campuses within Nepal. Thus, the system's participation base is broader than the domestic university totals alone suggest.

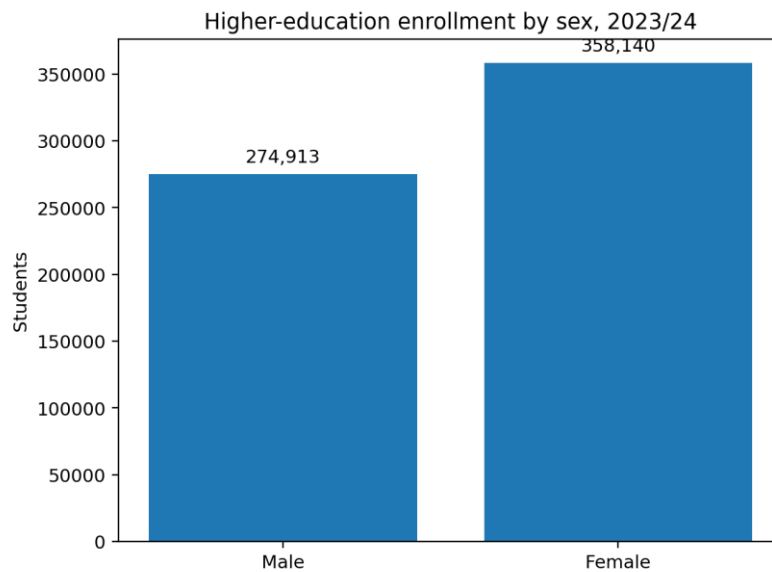


Figure 3. Higher-education enrollment by sex, 2023/24.

Indicator	Value	Derived measure
Domestic higher-education enrollment	633,053	100.00%
Female enrollment	358,140	56.57% of total
Male enrollment	274,913	43.43% of total
Female-to-male parity ratio	1.303	Female enrollment / male enrollment
Foreign-affiliated enrollment	28,073	4.25% of combined total
Combined domestic + foreign-affiliated	661,126	System participation base
UGC 18–22 population	3,000,698	Reference population
UGC-calculated GER	21.10%	Domestic enrollment / 18–22 population

The gender result is one of the more positive quantitative features of the system. Female students constitute about 56.57% of domestic higher-education enrollment, producing a female-to-male ratio of approximately 1.30. This indicates that access to higher education has not remained male-dominated in aggregate. However, national averages can conceal differences by field, geography, socioeconomic group, disability, ethnicity, and institutional type. Gender parity should therefore be complemented by disaggregated participation and completion indicators.

Case Study: Selected Universities

The selected-university comparison demonstrates the unusually concentrated nature of Nepal's higher-education system. According to UGC 2023/24 faculty/institute enrollment data, Tribhuvan University enrolled 491,299 students, Purbanchal University 39,780, Pokhara University 35,200, and Kathmandu University 21,053. Together these four institutions account for approximately 92.78% of domestic higher-education enrollment in the reported university dataset.

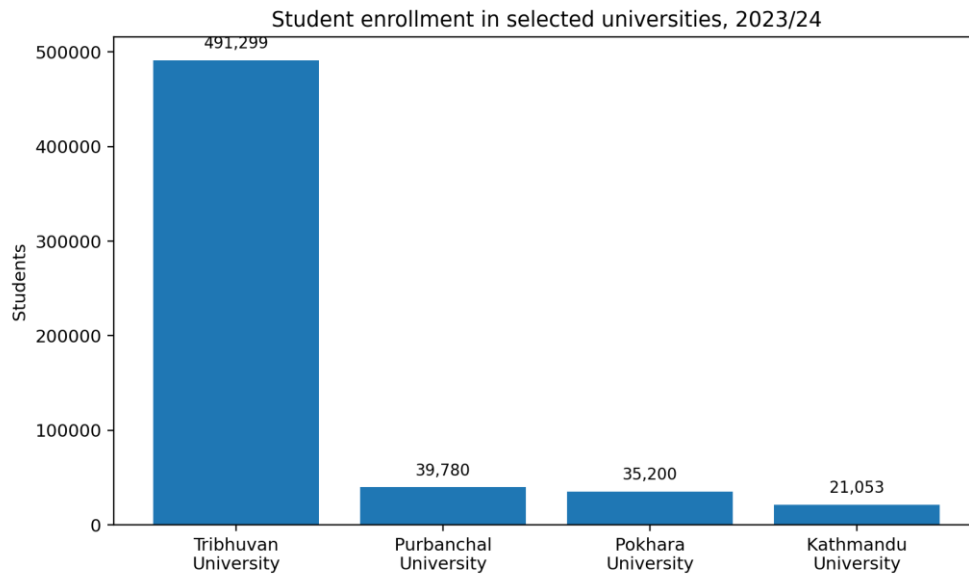


Figure 4. Student enrollment in four selected universities, 2023/24.

University	Enrollment	Share of domestic total	Graduates	Graduate share*
Tribhuvan University	491,299	77.61%	74,149	76.0%
Purbanchal University	39,780	6.28%	7,856	8.05%
Pokhara University	35,200	5.56%	7,651	7.84%
Kathmandu University	21,053	3.33%	3,077	3.15%
Selected four	587,332	92.78%	92,733	95.11% of the four named graduate totals

The concentration ratio C4 is calculated as $587,332 / 633,053 \times 100 = 92.78\%$. This is a structural feature rather than a simple weakness. Large institutions can generate economies of scale, broad disciplinary offerings, national reach, and extensive alumni networks. Yet extreme concentration can also produce administrative congestion, uneven student services, large affiliated-campus coordination burdens, and difficulties in ensuring consistent quality across thousands of learners and multiple campuses.

Tribhuvan University is particularly important because its enrollment is many times larger than that of any other university. That scale provides national reach but also makes reform at TU disproportionately important for the whole system. Conversely, smaller universities such as Kathmandu University can operate with a more focused academic portfolio, which may facilitate specialization and research intensity but can limit access and geographic coverage.

Disciplinary Structure of the Selected Universities

The internal distribution of students shows that Nepal's universities are strongly concentrated in a small number of fields, especially management and education. This pattern has implications for labor-market alignment, research specialization, and the distribution of scarce faculty resources.

University	Largest field	Students	Share within university
Tribhuvan University	Management	233021	47.43%
Tribhuvan University	Education	121718	24.77%
Tribhuvan University	Humanities & Social Sciences	63703	12.97%
Purbanchal University	Management	16834	42.32%
Pokhara University	Management	18606	52.86%
Pokhara University	Engineering	12238	34.77%
Kathmandu University	Medicine	10794	51.27%
Kathmandu University	Engineering	2407	11.43%

Three observations follow. First, management and education absorb a very large share of the student population, especially at TU. Second, Pokhara University has a comparatively strong engineering component, suggesting a more technically differentiated portfolio. Third, Kathmandu University's medical enrollment is dominant within its own structure, reflecting the high-resource nature of professional health education. These differences support a policy argument for differentiated funding and evaluation rather than a single institutional template.

Academic-Level Structure and Research Depth

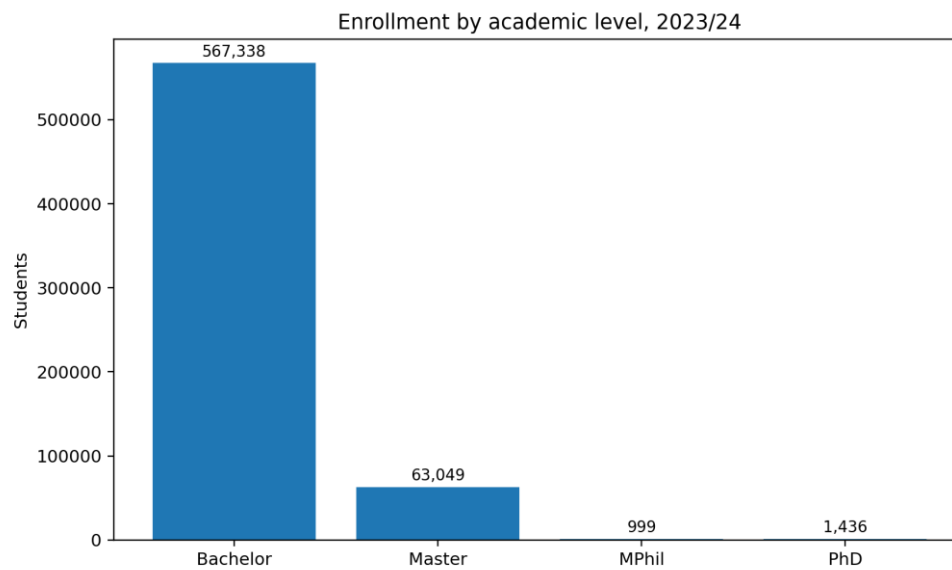


Figure 5. University enrollment by academic level, 2023/24.

Level	Enrollment	Share of total	Interpretation
Bachelor	567,338	89.62%	Very strong concentration at first-degree level
Master	63,049	9.96%	Substantial but much smaller than bachelor level
MPhil	999	0.16%	Very limited advanced research training

PhD	1,436	0.23%	Small national research-training base
MPhil + PhD	2,435	0.38%	Thin research-degree pipeline

The academic-level distribution is perhaps the clearest quantitative signal of Nepal's transition challenge. Bachelor's students account for 89.62% of reported university enrollment. Master's students account for 9.96%, while MPhil and PhD students together represent only about 0.38%. This does not mean that the system has failed in research; specialized universities and departments may have substantial research activity. It does mean, however, that the scale of formal advanced research training is small relative to the undergraduate base.

A useful policy metric is the postgraduate depth ratio. If $PGD = (63,049 + 999 + 1,436) / 633,053 \times 100$, the result is 10.34%. The ratio is not a quality score, but it highlights the narrowness of the advanced-degree pipeline. A research-intensive national system would normally require a stronger connection between undergraduate education, master's research, doctoral training, competitive grants, laboratories, journals, and industry or government research demand.

Access, Participation, and Gender Equity

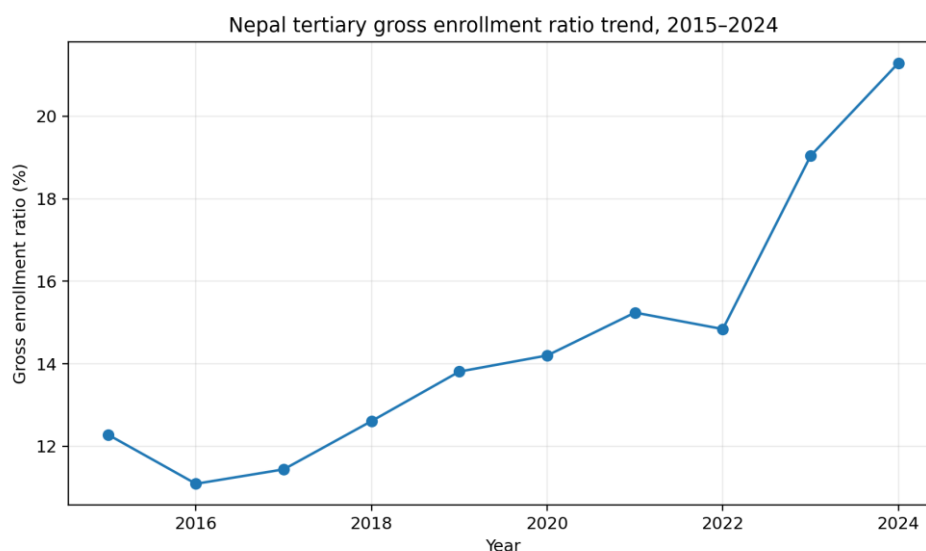


Figure 6. Nepal tertiary gross enrollment ratio trend, 2015–2024 (World Bank/UNESCO indicator series).

World Bank/UNESCO data indicate that Nepal's tertiary gross enrollment ratio rose from approximately 12.28% in 2015 to 21.29% in 2024. The direction of change is positive, although the ratio remains well below the levels observed in many higher-income systems. UGC's 2023/24 methodology, using the 18–22 population as the reference group, produces a national higher-education GER of about 22% when domestic enrollment is related to that population. The difference between indicators should not be interpreted as a contradiction: definitions, coverage, reference populations, and datasets differ.

Access also has a geographic dimension. Nepal's federal structure has encouraged the creation of provincial and regional universities, but the existence of an institution does not guarantee equitable access. Travel distance, household income, digital connectivity, language, disability access, and the perceived value of a degree influence participation. The Nepal Living Standards Survey IV, for example, shows substantial rural–urban differences in tertiary participation across provinces. This supports the argument that future expansion should target underserved populations rather than simply increase institutional count.

The gender parity result should similarly be interpreted carefully. The aggregate GPI of 1.30 means female enrollment is approximately 30% higher than male enrollment in the reported domestic total. This is an important achievement, but parity in access does not automatically imply parity in completion, employment, earnings, leadership, research participation, or representation across STEM fields. A stronger monitoring framework should therefore report gender-disaggregated indicators at entry, retention, graduation, employment, and research levels.

Financing and Resource Allocation

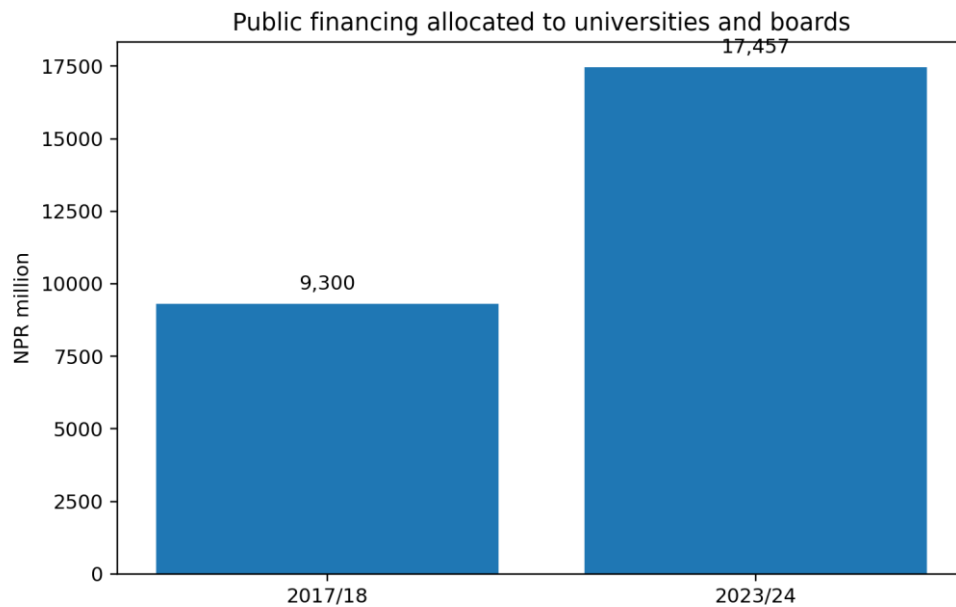


Figure 7. Public financing allocated to universities and boards, 2017/18 and 2023/24.

UGC reports that public financing allocated to Nepal's universities and boards increased from NPR 9,300 million in 2017/18 to NPR 17,457 million in 2023/24. The nominal increase is NPR 8,157 million, equivalent to an 87.71% rise over six years. The implied CAGR is approximately 11.07% per year.

Financing indicator	Calculation	Result
Nominal increase	$17,457 - 9,300$	NPR 8,157 million
Percentage increase	$8,157 / 9,300 \times 100$	87.71%
Six-year CAGR	$(17,457 / 9,300)^{(1/6)} - 1$	11.07% per year
2023/24 funding per domestic student	$17,457,000,000 / 633,053$	NPR 27,576

Financing growth is necessary but not sufficient. If expenditure rises while enrollment also rises, the effective resources available per student may grow much more slowly. Moreover, average funding can hide major differences across institutional missions. Medical training, laboratory-based science, engineering, teacher education, humanities, open learning, and research-intensive programs do not have the same cost structure. A single block-grant logic can therefore create cross-subsidies and incentives that are not aligned with institutional mission.

A mathematically stronger funding model would combine a base allocation with mission- and performance-sensitive components. A possible formula is $B_i = \alpha E_i + \beta R_i + \gamma Q_i + \delta S_i$, where E represents students, R research outputs, Q quality-assurance achievement, and S strategic social or regional service. The coefficients should be calibrated transparently and periodically reviewed. Such a formula would not eliminate political choices; it would make them explicit and auditable.

Faculty Capacity and Student–Teacher Ratios

UGC reports 12,082 teaching staff in constituent campuses in 2023/24, comprising professors, readers, lecturers, assistant lecturers, and instructors. The system-wide average, however, hides substantial institutional variation. The reported student–teacher ratio was about 21:1 for Tribhuvan University, 25:1 for Kathmandu University, 47:1 for Far-Western University, and 102:1 for Nepal Open University.

Institution	Students	Teachers	Reported STR	Interpretation
Tribhuvan University	174,487	8,122	21:1	Moderate pressure at system scale
Kathmandu University	12,185	~487	25:1	Higher but relatively balanced
Far-Western University	19,356	~412	47:1	High faculty pressure
Nepal Open University	—	—	102:1	Very high ratio; delivery model matters

The STR indicator must be interpreted with institutional design in mind. Open and distance universities can legitimately operate with different ratios because a teacher may serve students through digital course materials, asynchronous learning, and centralized assessment. Yet an extremely high ratio can still indicate limited academic advising, feedback, mentoring, research supervision, and student support. In laboratory and clinical programs, the ratio can be especially consequential because learning depends on physical facilities and close supervision.

An effective national dashboard should therefore report both crude STR and adjusted STR. An adjusted ratio could weight students according to delivery intensity: for example, laboratory/clinical students could receive higher weights than lecture-based students. This would produce a more meaningful measure of instructional pressure than a single unweighted ratio.

Quality Assurance and Accreditation

Nepal introduced higher-education quality assurance and accreditation mechanisms through the UGC, and quality assurance has become an increasingly visible policy instrument. UGC's recent quality-assurance reporting describes revisions to benchmarks and indicators and a move toward university-level accreditation linked to institutional participation in the QAA process. The UGC Strategic Plan 2024–2029 also identifies continuing weaknesses: QAA is not yet mandatory for all higher-education institutions, constituent campuses have been slow to enter the process, and institutions can struggle to dedicate staff to quality-assurance work.

The quantitative lesson is that accreditation coverage should be treated as a system penetration rate, not simply a count of awards. If A is the number of eligible institutions that have completed accreditation and N is the eligible institutional population, then QAA coverage = $A/N \times 100$. A second indicator should measure continuity: institutions maintaining accreditation after the first cycle divided by institutions initially accredited. A third should examine outcome improvement between cycles. This moves quality assurance from paper compliance toward continuous improvement.

Quality assurance should also be differentiated by institutional mission. A research university should be assessed strongly on research quality, doctoral supervision, laboratory capacity, and international collaboration. A regional teaching university should receive more weight for learning outcomes, student support, local employability, and community engagement. Applying identical indicators to radically different institutions risks producing compliance behavior rather than educational improvement.

Labor-Market Relevance, Student Migration, and Brain Drain

One of the strongest pressures on Nepal's domestic higher-education system is the movement of students toward foreign universities. Recent scholarly reviews identify academic quality, perceived employability, international exposure, migration opportunities, and broader economic considerations among the factors influencing study-abroad decisions. The issue is not merely that students leave; it is that persistent outward mobility can reduce domestic enrollment, weaken revenue stability, and create a feedback loop in which lower enrollment reduces institutional resources, which can further weaken quality and attractiveness.

The policy response should avoid simplistic narratives that blame students for leaving. International mobility can produce remittances, skills, networks, and eventual return migration. The more useful question is why domestic institutions are unable to capture a larger share of demand for high-quality education. The answer likely includes curriculum relevance, teaching quality, research opportunities, labor-market signaling, campus facilities, academic calendars, governance, and the credibility of degrees.

NEHEP, launched by the Government of Nepal and the World Bank, explicitly targets labor-market relevance, entrepreneurship, collaborative research, governance, access, and digital/blended learning. This direction is consistent with the mathematical analysis in this paper: the system should monitor not only enrollment but also graduate employment, employer satisfaction, internship participation, startup creation, research collaboration, and graduate retention.

Digital Transformation and Infrastructure

The COVID-19 pandemic accelerated the use of online learning in Nepal and exposed both the potential and limits of digital delivery. World Bank project documentation identified limited digital connectivity, the digital divide, incomplete regulatory provisions, and capacity constraints as major challenges. UGC has subsequently strengthened the concept of web-based HEMIS, emphasizing real-time data integration from campuses to universities and the UGC.

Digital transformation should therefore be treated as an institutional infrastructure project, not simply as the purchase of learning management software. A mature digital university requires reliable connectivity, learning platforms, digital libraries, student information systems, cybersecurity, teacher training, accessible content, data standards, backup systems, and interoperability. The mathematical performance indicators could include percentage of active courses using LMS, student login/engagement rates, course completion rates, average response time to students, system uptime, and proportion of academic records digitally verifiable.

A national HEMIS can become particularly valuable if it is used for decision support rather than annual reporting alone. For example, an early-warning model could estimate dropout risk using attendance, examination attempts, fee status, course load, and academic progression. The system could then target scholarships and advising before students disengage.

Governance, Autonomy, and Political Economy

Governance is a recurring challenge in Nepal's higher education. Scholarly work on strategic management argues that higher-education institutions need stronger capacity to design, implement, monitor, and evaluate strategies. Other studies point to political interference, leadership instability, bureaucratic delays, and weak institutional autonomy as constraints on quality improvement.

The governance problem can be represented as a principal-agent issue. The state and society expect universities to provide public value, while universities require sufficient autonomy to make academic and administrative decisions. Excessive control can slow decision-making; insufficient accountability can permit weak performance. The appropriate balance is therefore 'autonomy with measurable accountability.'

One practical approach is a compact of three layers: (1) national outcome indicators agreed with UGC and government; (2) university-specific performance contracts reflecting mission; and (3) transparent public dashboards. Indicators should include enrollment, retention, completion, QAA status, research funding, publications, graduate employment, student satisfaction, financial efficiency, and equity. The university should control how it achieves these outcomes, while the public system monitors whether outcomes improve.

Major Challenges: A Quantitative Synthesis

The evidence can be organized into eight interconnected challenges:

1. Concentration and scale: a small number of universities carry a very large share of students, increasing the importance of their governance and quality systems.
2. Undergraduate-heavy structure: 89.62% of university enrollment is at bachelor's level, while MPhil and PhD enrollment together remain below 0.5%.
3. Uneven faculty capacity: reported student–teacher ratios vary sharply across institutions, indicating differences in academic support capacity.
4. Quality-assurance coverage: accreditation is expanding but is not yet universal, and participation costs and staff capacity remain constraints.
5. Research weakness: the small research-degree pipeline, limited research financing, and weak industry linkages constrain knowledge production.
6. Labor-market mismatch and outward mobility: students may perceive foreign degrees as offering stronger employment, migration, or academic opportunities.
7. Digital inequality: connectivity and institutional capacity remain uneven, limiting the potential of online and blended learning.
8. Governance and financing: growing public expenditure needs to be translated into better outcomes through transparent, mission-sensitive allocation and institutional autonomy.

These challenges are mutually reinforcing. For example, weak governance can delay curriculum reform; outdated curricula can reduce employability; lower employability can increase study abroad; declining domestic enrollment can weaken institutional finances; and financial pressure can reduce investment in research and faculty development. Reform should therefore focus on system-level interactions rather than isolated projects.

Proposed Higher-Education Performance Scorecard

To operationalize the analysis, this paper proposes a composite scorecard. The score should not be used immediately as a high-stakes ranking; it is better suited to monitoring improvement within institutions and across time. A possible normalized score is:

$$\text{HPS} = 0.20A + 0.20Q + 0.15R + 0.15E + 0.10G + 0.10D + 0.10F$$

where A = access and equity, Q = quality assurance and learning outcomes, R = research and innovation, E = employability and relevance, G = governance, D = digital maturity, and F = financial efficiency. Each component can be normalized to 0–100 using nationally agreed benchmarks.

Dimension	Illustrative indicators	Suggested weight
Access & equity	GER, rural participation, female/male participation, scholarships, retention	20%
Quality	QAA status, learning outcomes, student support, course review	20%
Research	competitive grants, publications, doctoral students, patents/innovation	15%

Employability	graduate employment, internships, employer satisfaction, entrepreneurship	15%
Governance	leadership stability, audit, strategic-plan delivery, transparency	10%
Digital maturity	LMS use, digital library, HEMIS integration, uptime, staff training	10%
Financial efficiency	cost per graduate, funding diversification, budget execution	10%

The weighting is illustrative and should be validated through stakeholder consultation. The key principle is that enrollment should not dominate the measurement of university performance. An institution that enrolls many students but has weak completion, research, or employability should not automatically outperform a smaller institution that delivers strong outcomes.

Comparative Interpretation of the Four Case Universities

Tribhuvan University should be understood as a system within the system. Its scale means that even small changes in retention, graduation, faculty productivity, digital systems, or administrative efficiency can have national effects. Its broad disciplinary portfolio also makes mission differentiation essential: large teaching-oriented units and research-intensive units cannot be governed using identical performance rules.

Purbanchal University illustrates the role of an affiliating university serving a broad regional and professional market. Its strong management enrollment indicates high demand for business education, but this also raises the question of whether program supply is sufficiently diversified toward engineering, science, health, agriculture, digital technologies, and emerging occupations.

Pokhara University has a distinctive technical and professional profile, with substantial management and engineering enrollment. Its case suggests that specialization can coexist with scale. The strategic challenge is to maintain quality and research intensity while continuing to serve a broad student population.

Kathmandu University is much smaller in enrollment but has a notable concentration in medicine and engineering. Its experience demonstrates why size alone is an inadequate proxy for university quality. Smaller institutions can pursue specialized missions, but their financing must reflect the higher costs of laboratories, clinical training, research equipment, and specialized faculty.

Recommendations

Based on the quantitative findings and literature, the following reforms are recommended.

1. Adopt mission-based university differentiation. Classify institutions transparently by teaching, research, professional, regional, technical, and open-learning missions, and align indicators and financing accordingly.
2. Move from enrollment-centered to outcome-centered financing. Combine base funding with transparent incentives for completion, quality assurance, research, employability, and equity.
3. Strengthen doctoral and research pipelines. Expand competitive research grants, shared laboratories, doctoral scholarships, research management offices, and industry/government research partnerships.
4. Make QAA a continuous improvement system. Increase institutional participation while reducing administrative burden and providing dedicated quality-assurance capacity.
5. Create a national graduate-outcomes database. Track employment, further study, entrepreneurship, income bands where ethically feasible, employer satisfaction, and migration/return patterns.

6. Develop university–industry councils by discipline. Curricula should be reviewed with employers, professional bodies, alumni, and students at regular intervals.
7. Invest in digital public infrastructure. Build interoperable HEMIS, LMS, library, assessment, credential-verification, and analytics systems with strong cybersecurity and privacy safeguards.
8. Target equity geographically. Use participation data to identify districts and population groups with low tertiary access and direct scholarships, transport, digital support, and flexible programs accordingly.
9. Improve academic staffing models. Use workload-based staffing norms rather than a single student–teacher ratio, with separate benchmarks for laboratory, clinical, studio, online, and lecture-intensive programs.
10. Protect institutional autonomy while strengthening accountability. Universities should have greater operational freedom alongside public dashboards, independent audits, and measurable strategic targets.
11. Create a national retention and early-warning framework. Use HEMIS data to identify students at risk of dropout and connect them with advising, financial support, and academic interventions.
12. Publish annual mathematical scorecards. Every university should report a consistent set of indicators so that progress can be evaluated over time rather than through one-off narratives.

Limitations of the Study

This study is based on secondary data and therefore inherits the limitations of national reporting systems. Institutional data may differ in definitions, timing, coverage, and completeness. The UGC dataset is particularly useful for national comparisons, but aggregated figures cannot capture differences in teaching quality, student satisfaction, learning outcomes, research quality, or institutional culture.

The paper also does not estimate causal effects. For example, the association between public financing and enrollment does not establish that additional funding caused enrollment growth. Similarly, high student–teacher ratios are treated as capacity signals rather than direct measures of teaching quality. Finally, the four-university case study is illustrative rather than statistically representative of every university in Nepal.

Conclusion

Nepal's higher-education system is at an important transition point. The quantitative evidence shows meaningful expansion in participation, especially for women, and a substantial increase in the number and diversity of universities. At the same time, the system remains highly concentrated, undergraduate-heavy, uneven in faculty capacity, and relatively shallow in advanced research training. The four selected universities alone account for nearly 93% of domestic enrollment in the reported university faculty data, while bachelor's students represent nearly 90% of university enrollment.

The mathematical analysis therefore leads to a central conclusion: Nepal does not simply need 'more higher education'; it needs a better conversion of educational scale into outcomes. Public financing has grown substantially, but resources must be linked more directly to institutional mission, quality, research, equity, and employability. Gender participation has improved, but equity should be monitored beyond enrollment. Digital systems have expanded, but connectivity and institutional capability must catch up. Quality assurance has become more established, but it should evolve from accreditation compliance into continuous improvement.

The most important reform is a shift in the unit of policy attention: from counting universities, campuses, and students to measuring what students learn, whether they graduate on time, whether graduates find meaningful work, whether universities generate useful research, and whether public investment produces measurable social value. A transparent national scorecard, combined with mission-

based financing and stronger university autonomy, could help Nepal make this transition. The future competitiveness of Nepal's higher education will depend less on institutional expansion alone and more on the quality, relevance, research intensity, and credibility of the system as a whole.

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Appendix A. Key Mathematical Indicators

Indicator	Formula	Value / status
Female enrollment share	$358,140 / 633,053 \times 100$	56.57%
Male enrollment share	$274,913 / 633,053 \times 100$	43.43%
Gender parity index	$358,140 / 274,913$	1.303
Foreign-affiliated share	$28,073 / 661,126 \times 100$	4.25%
Selected-four concentration	$587,332 / 633,053 \times 100$	92.78%
Bachelor share	$567,338 / 633,053 \times 100$	89.62%
MPhil + PhD share	$2,435 / 633,053 \times 100$	0.38%
Funding growth	$(17,457-9,300)/9,300 \times 100$	87.71%
Funding CAGR	$(17,457/9,300)^{(1/6)}-1$	11.07%

Appendix B. Data Interpretation Notes

- The main institutional enrollment figures are taken from UGC EMIS 2023/24 university faculty/institute data.
- The UGC national GER uses the 18–22 population and domestic higher-education enrollment in the cited report.
- World Bank/UNESCO tertiary GER is a separate international indicator with its own definition and data pipeline.
- Student–teacher ratios are interpreted as capacity indicators, not direct measures of teaching quality.
- The proposed Higher-education Performance Scorecard is a policy framework developed for this paper and is not an official UGC ranking.