Research Square

Preprints are preliminary reports that have not undergone peer review.
They should not be considered conclusive, used to inform clinical practice,
or referenced by the media as validated information.

A multi criteria framework aligned with NAAC AQAR guidelines evaluates the performance of state open universities in India

Arvind Bhatt
Uttarakhand Open University
Geeta Mathpal
Uttarakhand Open University
Dr. Meenakshi Rana
mrana@uou.ac.in

Uttarakhand Open University
Akhil Godiyal
Uttarakhand Open University
Deepa Bisht
Uttarakhand Open University
Sukhwinder Rawat
Shri Guru Ram Rai University
Rajesh Mathpal
Uttarakhand Open University

Research Article

Keywords: Analytic hierarchy process (AHP), Technique for order preference by similarity to ideal solution (TOPSIS), Annual quality assurance report (AQAR), National assessment and accreditation council (NAAC), National institutional ranking framework (NIRF), All India survey on higher education (AISHE)

Posted Date: November 12th, 2026

DOI: https://doi.org/10.21203/rs.3.rs-11156055/v1

License: This work is licensed under a Creative Commons Attribution 4.0 International License.
Read Full License

Additional Declarations: No competing interests reported.

A multi criteria framework aligned with NAAC AQAR guidelines evaluates the performance of state open universities in India

Arvind Bhatt[a], Geeta Mathpal[a], Meenakshi Rana[b]*, Akhil Godiyal[a], Deepa Bisht[a], Sukhwinder Singh Rawat[c], Rajesh Mathpal[b]

[a] Department of Mathematics, Uttarakhand Open University, Haldwani, Uttarakhand, India

[b] Department of Mathematics, Uttarakhand Open University, Haldwani, Uttarakhand, India

[c] Department of Mathematics, School of Basic and Applied Sciences, Shri Guru Ram Rai University, Dehradun, Uttarakhand, India

Abstract

The present study develops an integrated Analytic Hierarchy Process-Technique for Order Preference by Similarity to Ideal Solution (AHP-TOPSIS framework) to evaluate and rank eight State Open Universities (SOUs) in India using seven quality criteria based on National Assessment and Accreditation Council (NAAC) accreditation framework and Annual Quality Assurance Reports (AQARs) frameworks**.** AHP was used to assign importance to criteria, while TOPSIS ranked universities according to their overall performance. NAAC accreditation, teaching-learning quality, and student support were found to be the most important factors. The ranking placed Dr. Babasaheb Ambedkar Open University first, followed by Karnataka State Open University and Uttarakhand Open University, while Uttar Pradesh Rajarshi Tandon Open University ranked lowest. The study highlights the importance of balanced performance across academic, administrative, and support areas for improving institutional quality.

Keywords: Analytic hierarchy process (AHP); Technique for order preference by similarity to ideal solution (TOPSIS); Annual quality assurance report (AQAR); National assessment and accreditation council (NAAC); National institutional ranking framework (NIRF); All India survey on higher education (AISHE).

*Corresponding Author: mrana@uou.ac.in

1. INRODUCTION

Higher education plays a fundamental role in fostering human capital, promoting innovation, and supporting sustainable socio-economic development. In recent years, ensuring quality in higher education has become a major policy priority worldwide owing to the rapid expansion of higher education institutions, increasing student enrolment, technological transformation, and the growing demand for accountability and institutional excellence (Chugh et al., 2023; Gonda, 2014; Ibrahim et al., 2014). Consequently, quality assurance and accreditation systems have emerged as essential mechanisms for evaluating institutional performance and promoting continuous quality improvement.

In India, ODL has become an important component of the higher education system by providing flexible, affordable, and inclusive educational opportunities to diverse learner groups, particularly those residing in geographically remote regions, working professionals, women, and socially disadvantaged communities (Misra & Sabharwal 2025*)*. According to the AISHE (https://aishe.gov.in/document/aishe-final-report-2021-22/?utm_source=chatgpt.com) 2021–22. India has 17 State and one National Open Universities, while several conventional universities also offer programmes through the ODL mode (Ministry of Education, 2024). The implementation of the National Education Policy (NEP) 2020 has further accelerated the digital transformation of higher education by promoting online learning, blended education, academic flexibility, multidisciplinary education, and technology-enabled teaching, thereby increasing the strategic importance of Open Universities in achieving equitable access to quality higher education (MoE, 2020).

To ensure academic quality and institutional accountability, the NAAC serves as the principal quality assurance agency for higher education institutions in India. NAAC evaluates universities using a comprehensive accreditation framework encompassing curriculum, teaching–learning processes, research and innovation, infrastructure, learner support, governance, institutional values, and best practices (NAAC, 2024). In addition to accreditation, the AQAR provides continuous evidence of institutional performance and quality enhancement initiatives. AQARs therefore represent a valuable source of standardized institutional information for objective performance assessment and comparative evaluation (https://law.imircindia.com/wpcontent/uploads/2024/12/1AQAR_Guideline_Universities_26042022.pdf.crdownload.pdf).

The increasing complexity of institutional evaluation has encouraged the adoption of Multi-Criteria Decision-Making (MCDM) techniques, which enable simultaneous assessment of multiple quantitative and qualitative criteria. Among these methods, the AHP (Saaty, 1980, 1990) and the TOPSIS (Hwang and Yoon, 1981; Hwang et al., 1993) are two of the most widely applied approaches because of their transparency, computational efficiency, and ability to incorporate expert judgment into complex decision-making problems. Recent studies have demonstrated the effectiveness of MCDM techniques in higher education quality assessment, institutional ranking, accreditation analysis, and strategic decision support (Behzadian et al., 2012; Kabak and Ervural, 2017; Benmoussa et al., 2019; Chakraborty, 2022; Alshamsi et al., 2023; Joshi et al., 2023; Srivastava et al., 2024; Tonbuloglu, 2024; Hussain et al., 2025). Furthermore, recent reviews indicate that hybrid MCDM frameworks integrating AHP, TOPSIS, fuzzy logic, and other intelligent decision-support techniques are increasingly being adopted for educational performance evaluation owing to their ability to address uncertainty and multidimensional assessment problems (Kumar, 2025).

Despite these developments, relatively few studies have focused on the systematic evaluation of Indian SOUs using standardized evidence derived from NAAC accreditation outcomes and AQAR reports. Existing institutional rankings generally emphasize accreditation grades or overall scores without adequately incorporating multiple dimensions of institutional performance, such as teaching–learning effectiveness, learner support, ICT infrastructure, governance, outreach, and affordability. Consequently, there remains a need for a transparent, evidence-based, and reproducible evaluation framework capable of providing a comprehensive assessment of institutional quality in the ODL sector (Thakur, 2026; Shinto, 2025).

To address this research gap, the present study proposes an integrated AHP–TOPSIS framework for evaluating and ranking selected (SOUs) in India. The proposed framework combines NAAC accreditation outcomes with AQAR-based institutional performance indicators to derive criteria weights using AHP and subsequently ranks universities using TOPSIS. By integrating quantitative accreditation measures with qualitative evidence-based institutional indicators, the proposed methodology provides a systematic, objective, and transparent approach for benchmarking institutional performance. The findings of this study are expected to support university administrators, accreditation agencies, and policymakers in quality assurance, strategic planning, and evidence-based decision-making for the continuous improvement of ODL institutions.

2. PRELIMINARIES

2.1. MCDM and Decision Matrix

MCDM is a decision-making framework used for problems in which multiple criteria must be evaluated simultaneously, requiring explicit consideration of trade-offs among competing criteria (Triantaphyllou, 2000). The MCDM usually required a decision matrix, which is a structured table used to compare multiple alternatives across a defined set of criteria. Each row represents an alternative, each column denotes a criterion, and the entries capture the observed or assigned performance values. This representation provides the basic input for systematic evaluation in MCDM methods.

2.2. AHP

The AHP, proposed by Saaty, (1980) is a structured decision-making method that decomposes complex problems into a hierarchical framework of criteria and alternatives. It derives priority weights through pairwise comparisons and evaluates the logical consistency of judgments to support reliable decision making.

2.2.1. Pairwise comparison matrix

A pairwise comparison matrix is a structured matrix used to express the relative importance of criteria by comparing them two at a time. Each element of the matrix reflects a judgment about how much more important one criterion is compared to another using a standardized scale. This approach helps convert subjective preferences into numerical weights in the AHP (Saaty, 1990).

2.2.2. Saaty's scale

Saaty's scale is a numerical scale used in AHP to compare criteria by expressing their relative importance. It employs values from 1 to 9 and their reciprocals to convert qualitative judgments into consistent quantitative comparisons (Saaty, 1990).

2.2.3. Column-wise summation

Column-wise summation is the process of adding all elements in each column of the pairwise comparison matrix in the AHP. These column totals are used to normalize the matrix for deriving relative priority weights of the criteria.

2.2.4. Normalised pairwise comparison matrix

The normalised pairwise comparison matrix is obtained by dividing each element of the pairwise comparison matrix by the sum of its corresponding column in the AHP. This step converts relative judgments into comparable proportions and enables the calculation of priority weights in a consistent manner.

$$\text{Each Value} = \frac{\text{original value}}{\text{column sum}}$$

2.2.5. Row-wise average calculation

Row-wise average calculation is the process of computing the average of each row in the normalised pairwise comparison matrix in the AHP. These averages represent the priority weights of the criteria and reflect their relative importance in the decision-making process.

2.2.6. Weighted sum vector (AW)

The AW is obtained by multiplying the pairwise comparison matrix with the priority weight vector in the AHP. It represents the combined effect of judgments and weights for each criterion and is used to assess the consistency of the comparison matrix.

$$AW_i = \sum_{j=1}^{n} a_{ij} \times w_j \quad (1)$$

Where, a_{ij} is an element of pairwise comparison matrix and w_j is the priority weight for each criterion.

2.2.7. Lambda (λ) values

The λ values represent the ratio of the weighted sum vector components to their corresponding priority weights in the AHP. These values are used to estimate the maximum eigenvalue of the pairwise comparison matrix and to check the consistency of the judgments made (Saaty, 1990).

$$\lambda_i = \frac{AW_i}{w_i} \quad (2)$$

2.2.8. Maximum eigenvalue (λ_{max})

The $\lambda_{\max}$ is a measure used in the AHP to evaluate the consistency of the pairwise comparison matrix. It is obtained by averaging the λ values and indicates how closely the judgments approximate perfect consistency (Saaty, 1990).

$$\lambda_{max} = \frac{1}{n}\sum_{i=1}^{n} \lambda_i \quad (3)$$

2.2.9. Consistency index (CI)

The CI is a numerical measure used in the AHP to evaluate the degree of consistency in the pairwise comparison judgments. It is computed using the maximum eigenvalue of the comparison matrix and indicates how much the judgments deviate from perfect consistency (Saaty, 1990).

$$CI = \frac{\lambda_{max} - n}{n-1} \quad (4)$$

2.2.10. Consistency ratio (CR)

The CR is a measure used in the AHP to assess the reliability of pairwise comparison judgments. It is obtained by comparing the CI with the Random Inconsistency (Random Index) and indicates whether the judgments are logically consistent (Saaty, 1990).

$$CR = \frac{CI}{\text{Random Inconsistemcy}} \quad (5)$$

2.2.11. Random inconsistency (RI)

The RI refers to the average level of inconsistency that arises in a pairwise comparison matrix when judgments are assigned randomly in the AHP. It is a standard reference value used to evaluate the CI and judge the reliability of comparison results.

2.2.12. Acceptable threshold

The acceptable threshold refers to the maximum permissible level of inconsistency allowed in pairwise comparison judgments in the AHP. It is used to decide whether the derived comparisons are sufficiently consistent to be considered reliable for further analysis. Acceptable Consistency Threshold ($n = 7$) if CR ≤ 0.10 implies judgments are correct, if CR > 0.10 implies judgments are inconsistent and should be revised (Saaty, 1990).

2.3. TOPSIS

The TOPSIS, developed by Hwang and Yoon, (1981) is a MCDM method that ranks alternatives based on their relative distance from an ideal and a negative-ideal solution. The preferred alternative is the one closest to the ideal solution and farthest from the worst.

2.3.1. Normalised matrix

In the TOPSIS (Hwang & Yoon, 1981), the normalised matrix is obtained by transforming the original decision matrix into a common comparable scale. This process removes the influence of differing units and magnitudes across criteria by proportionally scaling each value. The normalised matrix serves as the essential input for constructing the weighted matrix and determining ideal solutions in TOPSIS.

$$r_{ij} = \frac{x_{ij}}{\sqrt{\sum_{i=1}^{m} x^2{}_{ij}}} \text{ (vector normalisation)} \quad (6)$$

2.3.2. Weighted normalised matrix

In the TOPSIS (Hwang & Yoon, 1981), the weighted normalised matrix is obtained by applying criterion weights to the normalised matrix. It reflects the relative importance of each criterion and is used to determine ideal solutions for ranking alternatives.

$$v_{ij} = W_j \times r_{ij} \text{ (weighted normalised matrix)} \quad (7)$$

$$V = [v_{ij}] \text{ (weighted matrix)} \quad (8)$$

2.3.3. Ideal best and ideal worst

In the TOPSIS (Hwang & Yoon, 1981), the ideal best solution represents the most favourable values of all criteria, while the ideal worst solution represents the least favourable values. Alternatives are evaluated based on their relative closeness to the ideal best and distance from the ideal worst to determine rankings.

$$A^{+} = \max [v_{ij}] \quad (9)$$

$$A^{-} = \min [v_{ij}] \quad (10)$$

2.3.4. Separation measures

In the TOPSIS, separation measures quantify the distance of each alternative from the ideal best and ideal worst solutions. These distances indicate how close an alternative is to optimal performance and form the basis for final ranking (Yoon, 1987; Hwang et al., 1993).

$$D_1{}^{+} = \sqrt{\sum \left(v_{ij} - A_1{}^{+}\right)^2} \quad (11)$$

$$D_1{}^{-} = \sqrt{\sum \left(v_{ij} - A_1{}^{-}\right)^2} \quad (12)$$

2.3.5. Closeness coefficient

In the TOPSIS, the closeness coefficient measures how near an alternative is to the ideal best solution relative to the ideal worst. A higher closeness coefficient indicates better overall performance and determines the final ranking of alternatives (Yoon, 1987; Hwang et al., 1993).

$$CC_i = \frac{D_i^{-}}{D_i^{+} + D_i^{-}}. \quad (13)$$

2.4. Rubric

A rubric is an explicit and structured scoring guide that outlines criteria for evaluating performance along with descriptions of varying levels of quality for each criterion (Popham, 1997). Rubrics are designed to make assessment judgments more consistent, transparent, and

objective by clearly communicating expectations and performance standards to both evaluators and learners.

3. METHODOLOGY

The present work employs an integrated AHP–TOPSIS framework to evaluate and rank the performance of selected SOUs in India. The AHP method is first used to determine the relative importance of the evaluation criteria through pairwise comparisons and consistency analysis. The derived criteria weights are subsequently incorporated into the TOPSIS method to rank the universities according to their relative closeness to the ideal institutional performance profile.

The evaluation framework comprises seven criteria: C_1 = NAAC CGPA, representing overall institutional quality; C_2 = Teaching–Learning Effectiveness, reflecting academic delivery and learner engagement; C_3 = Student Support and Progression, assessing learner support services and progression; C_4 = ICT Infrastructure, evaluating digital resources and technological readiness; C_5 = Outreach and Accessibility, measuring institutional inclusiveness and regional outreach; C_6 = Governance and Management, representing administrative effectiveness and leadership; and C_7 = Affordability, reflecting the economic accessibility of academic programmes.

Since criteria (C_2–C_7) represent qualitative institutional characteristics, an evidence-based five-level rubric was developed to transform qualitative information into quantitative scores suitable for multi-criteria decision-making. The rubric consists of five performance levels (R_1–R_5), as illustrated in Fig. 1.

R_1 = Very Weak, R_2 =Basic, R_3 = Adequate, R_4= Strong, and R_5= Very Strong

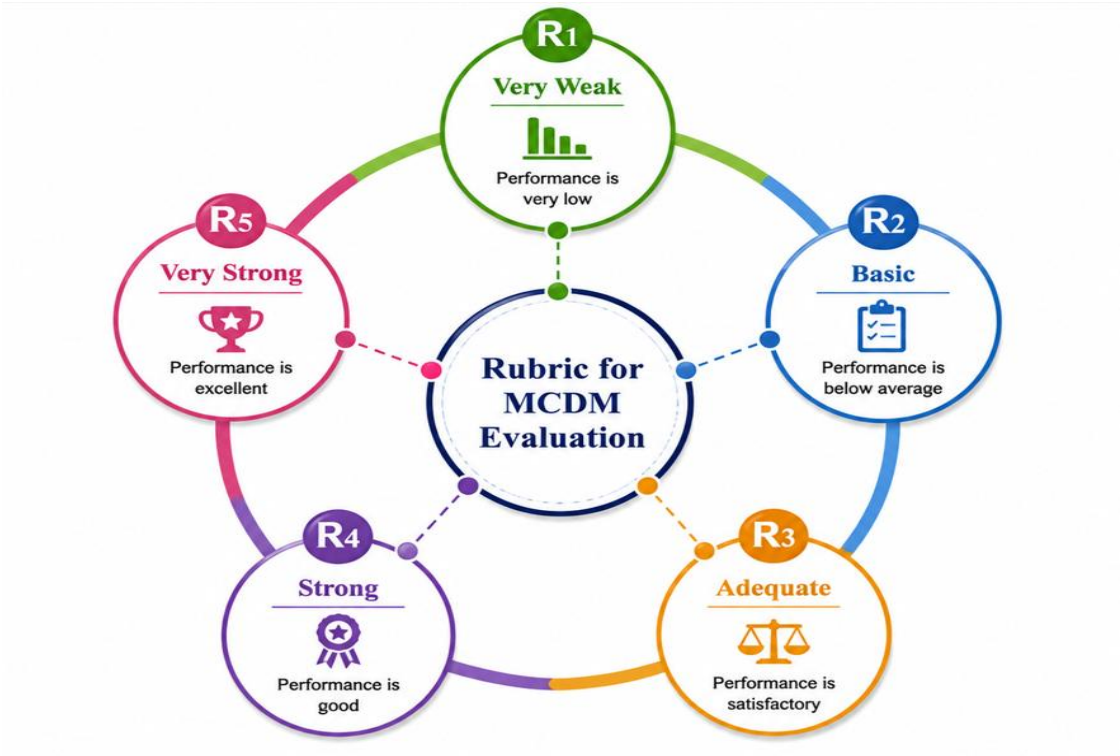


Fig. 1: Rubric assessment levels (R_1 – R_5) adopted for qualitative criteria evaluation.

Rubric scores were assigned based on evidence extracted from the AQARs, Centre for Internal Quality Assurance (CIQA) reports, and other official institutional documents. The criterion-specific rubric definitions Tables 1 to 6 and the corresponding university-wise evidence-based scoring

3.1 Selection of Evaluation Criteria

3.1.1. NAAC-CGPA (C_1)

NAAC Cumulative Grade Point Average (CGPA) is the final quantitative score awarded by NAAC after comprehensive institutional assessment. It represents overall institutional quality across teaching, research, infrastructure, student support, and governance. NAAC score is the only nationally standardised and openly available measurable quality indicator for Indian universities. It integrates multiple dimensions of institutional performance into a single score. For SOUs, NAAC score serves as an unbiased benchmark of trustworthiness and quality assurance and hence making it an essential baseline criterion in comparative evaluation.

3.1.2. Effectiveness of teaching learning (NAAC criterion II) (C_2)

This criterion evaluates the efficacy of teaching and learning processes, including course delivery, learner engagement, academic practices, assessment methods, and academic support

in the online distance learning environment. Teaching–learning is the fundamental function of any educational institution. In open universities, effective pedagogy ensures firm learning despite the barrier of physical separation between students and teachers. Online distance learning institutions depend heavily on self-learning materials, online counselling, ICT assisted delivery, and student centric approach. NAAC Criterion II highlights these characteristics, making this criterion essential to quality assessment. Qualitative measures cannot be measured directly hence Rubric method is used.

Table 1. Rubric based scoring through evidence-based logic on effectiveness of teaching learning (NAAC Criterion II).

Score	Rubric meaning	How this score was decided (evidence logic)
1	R_1	AQAR reports only printed Study learning material, negligible academic interaction and no ICT support.
2	R_2	Designed study learning material exists but only partial counselling is provided, with negligible use of ICT.
3	R_3	Consistent counselling, defined teaching and learning process of teaching and learning and limited ICT support.
4	R_4	ICT empowered learner support, learning management system use, proper online counselling clearly reported.
5	R_5	Result based online distance learning pedagogy, cooperative digital learning, implements best practices and innovations.

3.1.3. Student's support and progress (C_3)

This criterion measures the extent to which institutions provide support to learners in which counselling services, grievance redressal, scholarships, career guidance and assistance to student academic progress are included. Strong student support systems improve the retention ratio, course completion rates and ensures high level of learner satisfaction. SOUs cater to working professionals, rural learners, and disadvantaged groups.

Table 2. Rubric based scoring for quantitative measurement of student's support and progress.

Score	Rubric meaning	How this score was decided (evidence logic)
1	R_1	No structured learner support mentioned.
2	R_2	Limited counselling or grievance mechanism.
3	R_3	Counselling and grievance redressal exist.

4	R_4	Scholarships, counselling, grievance redressal clearly documented.
5	R_5	Comprehensive learner support, progression tracking, career guidance.

3.1.4. Information communication technology and infrastructure (C_4)

This criterion assesses the readiness and effectiveness of information and communication technology infrastructure, including learning management systems (LMS), electronic content availability and online institutional services available to students. ICT plays a vital role in flexible and cooperative education. Superior digital infrastructure improves accessibility and learning outcomes. The NAAC online distance learning manual places strong prominence on ICT enabled teaching and learning process thereby making this criterion of great importance.

Table 3. Rubric based scoring for information communication technology and infrastructure.

Score	Rubric meaning	How this score was decided (evidence logic)
1	R_1	Negligible or no digital infrastructure.
2	R_2	Limited ICT facilities available (website only).
3	R_3	Basic LMS available, some electronic resources available.
4	R_4	LMS, digital resources and online services well unified.
5	R_5	Advanced digital ecosystem, extensive electronic content available, innovation and development of resources for better understanding of learner.

3.1.5. Outreach and Accessibility (C_5)

This criterion measures the level of institutional outreach which includes geographic coverage, network of study centre, opportunities for rural and remote learners and initiatives to ensure more and more students get benefit for the running programs. Outreach reflects the institution's role in increasing access to higher education, a key policy goal in India. Extensive outreach and convenience are therefore defining nature of their role and performance.

Table 4. Rubric based scoring for measuring outreach and accessibility.

Score	Rubric meaning	How this score was decided (evidence logic)
1	R_1	Negligible geographic reach and study centres.
2	R_2	Limited geographic outreach and few study centres.
3	R_3	Adequate study centres and State level study centre coverage.
4	R_4	Wide district coverage, strong rural outreach with large number of study centres in every district/region.

5	R_5	Extensive outreach with inclusive access to remote and rural learners. Focus on creating inclusive environment for learning of leaners with multiple study centres in every region.

3.1.6. Governance, leadership, and management (C_6)

This criterion evaluates governance framework, leadership effectiveness, strategic planning, internal quality assurance control framework (IQAC), and organizational transparency. Effective governance safeguards institutional stability, accountability, and continuous quality improvement. Given their large urban and rural learner base, open universities need strong governance systems to manage academic delivery, logistics, and regulatory framework.

Table 5. Rubric based scoring for Governance, Leadership and management.

Score	Rubric meaning	How this score was decided (evidence logic)
1	R_1	No quality assurance framework.
2	R_2	Informal governance framework with no IQAC.
3	R_3	IQAC exists with basic governance system and e-governance.
4	R_4	Structured governance framework exists with e-governance and transparency, proper IQAC framework is followed.
5	R_5	Strategic leadership, best governance practices followed with e-governance. Proper IQAC framework is followed.

3.1.7. Affordability (C_7)

Affordability measures the cost of education, fee transparency, availability of financial assistance and overall economic viability of multiple academic programmes to the learners. Reasonable education promotes fairness, inclusion and social flexibility, positioning higher education with national development goals. SOUs majorly serve economically weaker and marginalised sections. New Education Policy 2020 emphasises on affordability as a main principle, thereby making this criterion essential for evaluating open universities.

Table 6. Rubric based scoring for measuring affordability of courses offered by Open Universities.

Score	Rubric meaning	How this score was decided (evidence logic)
1	R_1	High fees with no financial support to learners.
2	R_2	Moderate fees with limited transparency. Negligible financial support.
3	R_3	Reasonable fees with fair transparency. Limited financial support.

4	R_4	Affordable fees, with fair transparent frame and financial support.
5	R_5	Very low fees with strong focus on equity and inclusion. Completely transparent framework. Various financial support opportunities given to students.

3.2. Criterion-wise Performance Assessment of Selected SOUs

The evidence-based rubric developed in the previous subsection was applied to evaluate the performance of the selected SOUs under each assessment criterion. Criterion-wise scores were assigned using evidence extracted from the NAAC accreditation reports, AQARs, CIQA reports, and other official institutional documents. The assigned scores provide the quantitative input required for the subsequent AHP–TOPSIS analysis and are presented in Fig. 2 and Tables 7.

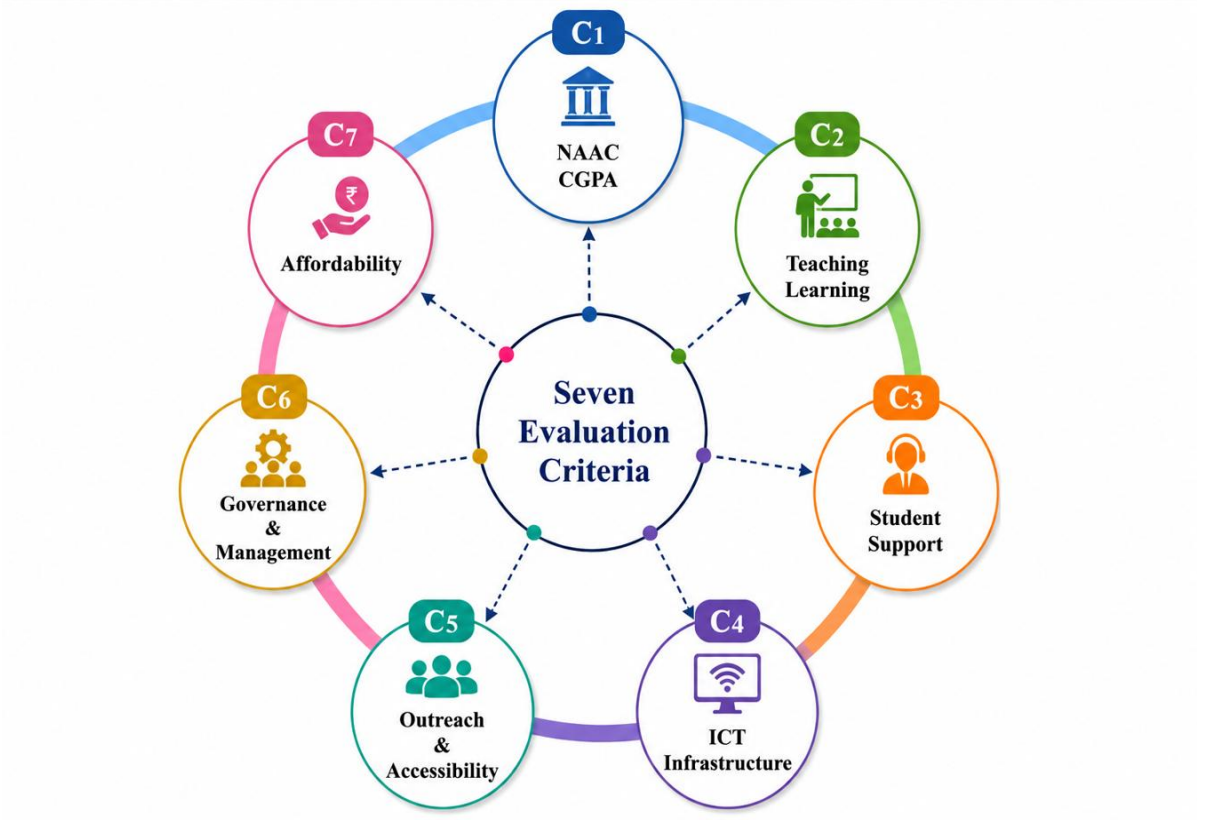


Fig. 2: Seven evaluation criteria (C_1–C_7) used for assessing SOUs.

For OSOU, rubric scores were derived from the CIQA Annual Report 2024–25 (OSOU, 2025), as the 2023–24 quality assurance report was not available in the public domain at the time of data collection. The CIQA report represents the latest officially accessible institutional quality documentation and follows NAAC-aligned indicators prescribed for (ODL) institutions. The use of the most recent publicly available report ensures data relevance while maintaining

methodological consistency and comparability with assessments conducted for other universities.

The proposed AHP–TOPSIS framework adopted in this study for evaluating the performance of selected SOUs is illustrated in Fig. 3. The framework integrates NAAC accreditation outcomes with AQAR-based rubric scores to construct the decision matrix. Subsequently, the AHP is employed to determine the relative weights of the evaluation criteria through pairwise comparisons and consistency analysis. These weights are then incorporated into the TOPSIS method to compute the closeness coefficient and obtain the final ranking of the universities.

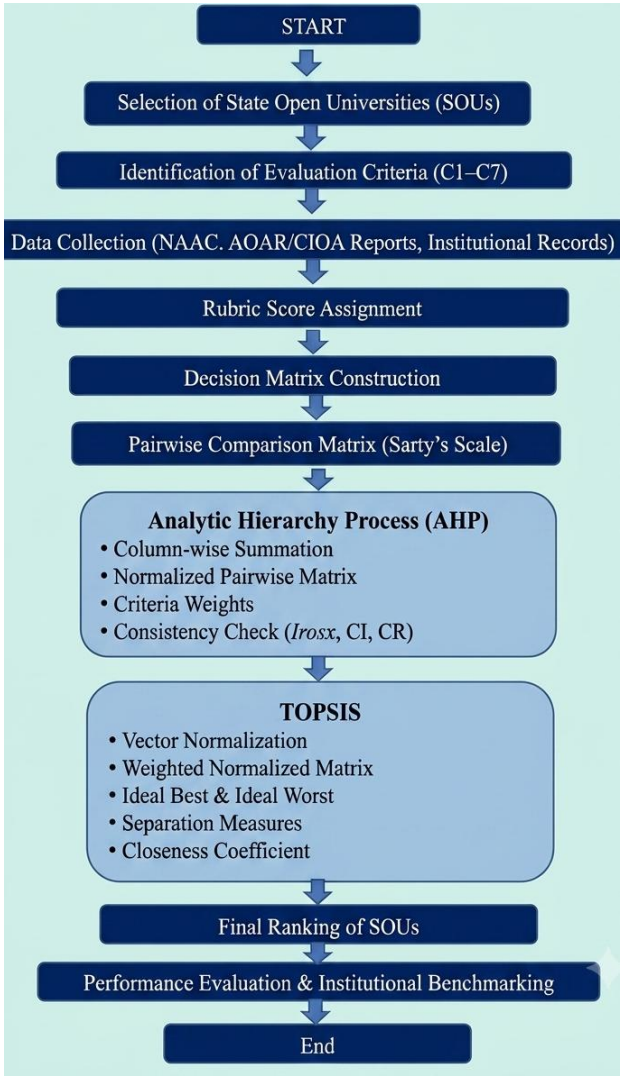


Fig. 3: The AHP–TOPSIS framework used to transform NAAC AQAR–based rubric scores into the final performance ranking of the selected SOUs.

4. RESULTS AND DISCUSSION

The proposed methodology employs a hybrid AHP–TOPSIS approach to evaluate the relative performance of selected SOUs in India. Initially, AHP is used to determine the relative importance (weights) of the evaluation criteria based on expert judgments. Subsequently, TOPSIS ranks the universities by measuring their relative distances from the ideal and negative-ideal solutions. The evaluation framework incorporates NAAC-CGPA accreditation outcomes together with key performance indicators extracted from the AQARs, ensuring a comprehensive and transparent assessment of institutional quality.

4.1 Initial Decision Matrix

The decision matrix was constructed using the NAAC CGPA and AQAR-derived rubric scores for the selected State Open Universities. This matrix served as the input for the AHP and TOPSIS analyses.

Table 7. Initial decision matrix for the AHP–TOPSIS evaluation of selected SOUs.

University	C_1	C_2	C_3	C_4	C_5	C_6	C_7
UOU	2.77	4	4	4	5	3	5
BAOU	3.55	4	4	4	3	4	3
KSOU	3.31	4	4	4	3	4	3
YCMOU	3.02	3	3	3	4	3	4
VMOU	3.13	3	3	3	4	3	4
TNOU	3.32	3	3	3	4	3	4
OSOU	2.89	3	4	3	4	3	4
UPRTOU	2.60	2	3	2	4	3	5

C1: Quantitative official NAAC CGPA score; C2 to C7: Qualitative rubric metrics mapped from institutional AQAR/CIQA disclosures (encompassing ICT deployment, learner support systems, core infrastructure, regional outreach, governance benchmarks, and financial affordability).

4.2 AHP-Based Criteria Weighting

Table 8 presents the pairwise comparison matrix constructed using Saaty's nine-point scale. Each criterion is compared with every other criterion to determine its relative importance in the decision-making process. The diagonal elements are equal to 1 because each criterion is equally important when compared with itself. The values above the diagonal represent the degree to which the row criterion is more important than the column criterion, whereas the reciprocal values below the diagonal indicate the opposite relationship. For example, the value

of 2 in the first row and second column indicates that criterion (C_1) is moderately more important than C_2), while the corresponding value of (1/2) reflects the inverse comparison.

Table 8. Pairwise comparison matrix of the evaluation criteria based on Saaty's nine-point scale.

Criteria	C_1	C_2	C_3	C_4	C_5	C_6	C_7
C_1	1	2	3	4	5	6	7
C_2	$\frac{1}{2}$	1	2	3	4	5	6
C_3	$\frac{1}{3}$	$\frac{1}{2}$	1	2	3	4	5
C_4	$\frac{1}{4}$	$\frac{1}{3}$	$\frac{1}{2}$	1	2	3	4
C_5	$\frac{1}{5}$	$\frac{1}{4}$	$\frac{1}{3}$	$\frac{1}{2}$	1	2	3
C_6	$\frac{1}{6}$	$\frac{1}{5}$	$\frac{1}{4}$	$\frac{1}{3}$	$\frac{1}{2}$	1	2
C_7	$\frac{1}{7}$	$\frac{1}{6}$	$\frac{1}{5}$	$\frac{1}{4}$	$\frac{1}{3}$	$\frac{1}{2}$	1

Each element of the pairwise comparison matrix represents the relative importance of the row criterion with respect to the corresponding column criterion.

Table 9. Column-wise sums of the pairwise comparison matrix for the evaluation criteria.

Criteria	Obtained sum
C_1	2.593
C_2	4.450
C_3	7.283
C_4	11.083
C_5	15.833
C_6	21.500
C_7	28.000

Table 9 shows the sum of each column of the pairwise comparison matrix. These column totals are used to normalize the matrix by dividing every element in a column by the corresponding column sum. This normalization ensures that all criteria are evaluated on a common scale, allowing the relative importance of each criterion to be determined objectively.

Table 10. Normalised pairwise comparison matrix.

Criteria	C_1	C_2	C_3	C_4	C_5	C_6	C_7
C_1	0.386	0.449	0.412	0.361	0.316	0.279	0.250
C_2	0.193	0.225	0.275	0.271	0.253	0.233	0.214
C_3	0.129	0.112	0.137	0.180	0.189	0.186	0.179
C_4	0.096	0.075	0.069	0.090	0.126	0.140	0.143
C_5	0.077	0.056	0.046	0.045	0.063	0.093	0.107
C_6	0.064	0.045	0.034	0.030	0.032	0.047	0.071
C_7	0.055	0.037	0.027	0.023	0.021	0.023	0.036

Table 10 presents the normalized pairwise comparison matrix obtained by dividing each element of the original comparison matrix by the sum of its respective column. As a result, the sum of each column becomes approximately equal to one. The normalized values represent the relative contribution of each criterion with respect to all other criteria and provide the basis for calculating the priority weights.

Table 11. Priority vector (criteria weights) obtained from the normalized pairwise comparison matrix.

Criteria	Weights (W_i)
C_1	W_1 = 0.350
C_2	W_2 = 0.237
C_3	W_3 = 0.159
C_4	W_4 = 0.106
C_5	W_5 = 0.070
C_6	W_6 = 0.046
C_7	W_7 = 0.032

Table 11 presents the priority vector (criteria weights), which is obtained by calculating the average of the normalized values across each row of the normalized matrix. These weights indicate the relative importance of each evaluation criterion in the AHP model. Among all the criteria, (C_1) has the highest weight (0.350), indicating that it is the most influential criterion in the decision-making process. This is followed by (C_2) (0.237), (C_3) (0.159), and (C_4) (0.106). The remaining criteria, (C_5), (C_6), and (C_7), have progressively lower weights of

0.070, 0.046, and 0.032, respectively. These weights are subsequently used to compute the weighted sum vector and to perform the consistency analysis of the pairwise judgments.

4.3 Consistency Analysis

Table 12 presents the weighted sum vector (AW), which is obtained by multiplying the pairwise comparison matrix with the priority vector (criteria weights) derived from the normalized matrix. Each value in the weighted sum vector represents the weighted contribution of a criterion based on its relative importance and pairwise comparison judgments. The weighted sum vector is a crucial intermediate step in the AHP methodology, as it is used to compute the consistency vector by dividing each weighted sum value by its corresponding priority weight. The resulting consistency vector is then used to determine the maximum eigenvalue (λ_{max}), which forms the basis for calculating the CI and the CR. These measures verify the logical consistency and reliability of the pairwise comparison judgments.

Table 12. Weighted sum vector of the pairwise comparison matrix.

Criteria	Weighted sum vector (AW_i)
C_1	$AW_1 = 2.572$
C_2	$AW_2 = 1.747$
C_3	$AW_3 = 1.158$
C_4	$AW_4 = 0.757$
C_5	$AW_5 = 0.493$
C_6	$AW_6 = 0.325$
C_7	$AW_7 = 0.226$

The consistency vector (λ_i) was calculated using equation 2 and presented in Table 13.

Table 13. Computed Lambda values.

Criteria (C_i)	AW_i	W_i	Lambda values (λ_i)
C_1	2.572	0.350	7.341
C_2	1.747	0.237	7.359
C_3	1.158	0.159	7.286
C_4	0.757	0.106	7.169
C_5	0.493	0.070	7.073

C_6	0.325	0.046	7.049
C_7	0.226	0.032	7.105

The maximum eigenvalue (λ_{max}) was computed as the arithmetic mean of the individual λ_i values obtained from Table 13. The consistency of the pairwise comparison matrix was then evaluated using the Consistency Index (CI) and Consistency Ratio (CR), as follows:

Now find maximum eigen value (λ_{max}), CI, and CR as follows:

1. Maximum eigen value (λ_{max}) = $\frac{1}{n}\sum_{i=1}^{n}\lambda_i$ =7.197.

2. CI = $\frac{\lambda_{max}\ -n}{n-1}$,= $\frac{(7.197-7)}{6}$ = 0.033.

3. CR = $\frac{\text{CI}}{\text{Random Inconsistemcy}}$.

Acceptable Consistency Threshold ($n = 7$). If CR ≤ 0.10 implies judgments are correct, if CR > 0.10 implies judgments are inconsistent and should be revised (Saaty, 1980, 1990).

For $n = 7$, the random inconsistency is 1.32 (standard Saaty value).

Hence, the CR is $\frac{0.033}{1.32}$ = 0.025. Since the CR is 0.025, which is less than the acceptable threshold 0.10. Hence the pairwise comparison judgments are considered sufficiently consistent and suitable for subsequent TOPSIS analysis.

4.4 TOPSIS Evaluation

After establishing the priority weights of the evaluation criteria through AHP and confirming the consistency of the pairwise comparisons (CR = 0.025), the TOPSIS method was implemented to evaluate the relative performance of the selected SOUs. The initial decision matrix described in Table 13 was used as the input for the TOPSIS analysis. The matrix consists of seven benefit criteria, including the NAAC accreditation score (C_1) and six AQAR-derived institutional performance indicators (C_2–C_7). To remove the effect of differing measurement scales and facilitate meaningful comparisons among universities, the decision matrix was transformed into a dimensionless form using vector normalization, as defined in equation (6). The normalized decision matrix obtained from this procedure is presented in Table 14.

Table 14. Normalized decision matrix for the TOPSIS evaluation of selected SOUs.

University	C_1	C_2	C_3	C_4	C_5	C_6	C_7
UOU	0.317	0.426	0.400	0.426	0.451	0.323	0.435
BAOU	0.406	0.426	0.400	0.426	0.271	0.431	0.261
KSOU	0.379	0.426	0.400	0.426	0.271	0.431	0.261
YCMOU	0.346	0.320	0.300	0.320	0.361	0.323	0.348
VMOU	0.358	0.320	0.300	0.320	0.361	0.323	0.348
TNOU	0.380	0.320	0.300	0.320	0.361	0.323	0.348
OSOU	0.331	0.320	0.400	0.320	0.361	0.323	0.348
UPRTOU	0.298	0.213	0.300	0.213	0.361	0.323	0.435

The decision matrix was normalized using the vector normalization method to eliminate the influence of different measurement scales among the evaluation criteria. Each element of the normalized decision matrix was calculated according to Equation (6), in which each criterion value was divided by the square root of the sum of squared values for that criterion across all universities. This transformation converts the original decision matrix into a dimensionless form while preserving the relative performance of the alternatives. The normalized values obtained are presented in Table 14.

Subsequently, the weighted normalized decision matrix was obtained by multiplying each normalized value by its corresponding AHP-derived criterion weight using equation 7 and 8. The resulting weighted normalized decision matrix is presented in Table 15.

Table 15. Weighted normalized decision matrix for the TOPSIS evaluation of selected SOUs.

University	C_1	C_2	C_3	C_4	C_5	C_6	C_7
UOU	0.11	0.101	0.064	0.045	0.031	0.015	0.014
BAOU	0.142	0.101	0.064	0.045	0.019	0.020	0.008
KSOU	0.133	0.101	0.064	0.045	0.019	0.020	0.008
YCMOU	0.121	0.076	0.048	0.034	0.025	0.015	0.011
VMOU	0.126	0.076	0.048	0.034	0.025	0.015	0.011
TNOU	0.133	0.076	0.048	0.034	0.025	0.015	0.011
OSOU	0.116	0.076	0.064	0.034	0.025	0.015	0.011
UPRTOU	0.104	0.051	0.048	0.023	0.025	0.015	0.014

The positive ideal solution (A^+) and the negative ideal solution (A^-) were determined using Equations (9) and (10), respectively. Since all evaluation criteria are benefit attributes, the positive ideal solution consists of the maximum weighted normalized value for each criterion, whereas the negative ideal solution consists of the corresponding minimum weighted normalized value. The resulting ideal best and ideal worst values are presented in Table 16.

Table 16. Positive and negative ideal solutions for the TOPSIS evaluation of selected SOUs.

Criteria	Ideal Best (A_j^+)	Ideal Worst (A_j^-)
C_1	0.142	0.104
C_2	0.101	0.051
C_3	0.064	0.048
C_4	0.045	0.023
C_5	0.031	0.019
C_6	0.020	0.015
C_7	0.014	0.008

The separation measures from the positive ideal solution (D_1^+) and the negative ideal solution (D_1^-) were calculated using Equations (11) and (12), respectively. These measures represent the Euclidean distances of each university from the positive and negative ideal solutions. A smaller value of (D_1^+) indicates that an alternative is closer to the ideal solution, whereas a larger value of (D_1^-) indicates a greater distance from the negative ideal solution. The computed separation measures are presented in Table 17.

Table 17. Separation measure form Ideal Best and Ideal Worst values of SOUs.

University	D_1^+	D_1^-
UOU	0.032	0.060
BAOU	0.014	0.069
KSOU	0.017	0.064
YCMOU	0.039	0.033
VMOU	0.037	0.036
TNOU	0.034	0.041
OSOU	0.039	0.035
UPRTOU	0.070	0.0008

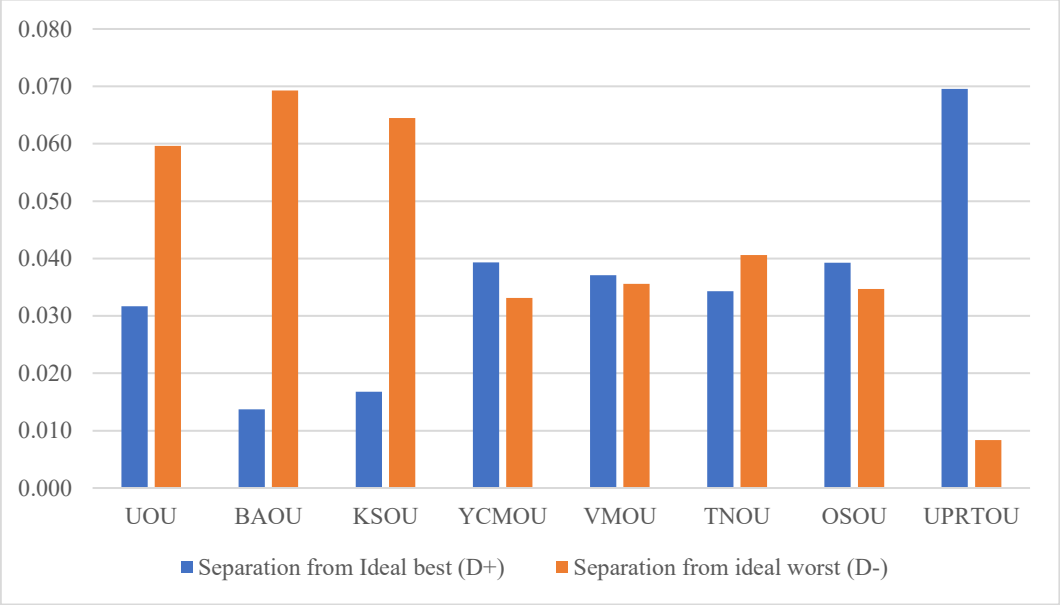


Fig. 4: Separation measures from ideal best and ideal worst values.

The relative closeness coefficient (CC_i) of each university to the positive ideal solution was calculated using Equation (13). The closeness coefficient combines the separation measures from both the positive and negative ideal solutions into a single performance index. A higher CC_i value indicates that an alternative is closer to the positive ideal solution and farther from the negative ideal solution, reflecting superior overall performance. The calculated closeness coefficients and the corresponding rankings of the selected SOUs are presented in Table 18.

Table 18. Final ranking of selected SOUs based on TOPSIS closeness coefficients.

University	Closeness Coefficient (CC_i)	Rank
BAOU	0.835	1
KSOU	0.794	2
UOU	0.653	3
TNOU	0.542	4
VMOU	0.490	5
OSOU	0.469	6
YCMOU	0.458	7
UPRTOU	0.107	8

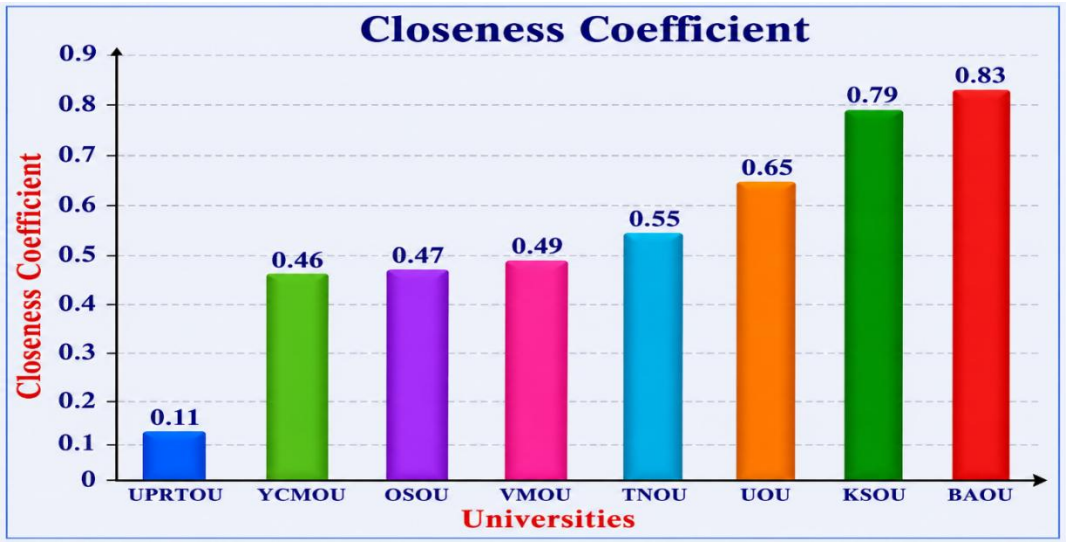


Fig. 5: Closeness Coefficient values and resulting TOPSIS ranking of the selected SOUs.

The TOPSIS results indicate that BAOU achieved the highest closeness coefficient (0.835), followed by KSOU (0.794) and UOU (0.653), indicating their closest proximity to the positive ideal solution. Conversely, UPRTOU obtained the lowest closeness coefficient (0.107), suggesting the greatest distance from the ideal institutional performance profile. These results demonstrate that universities exhibiting consistently strong performance across all evaluation criteria attain higher overall rankings. The integrated AHP–TOPSIS framework therefore provides a robust, transparent, and objective approach for benchmarking institutional performance and supporting evidence-based quality improvement in State Open Universities.

5. CONCLUSION

This study introduces a robust, integrated AHP–TOPSIS framework to evaluate the performance of selected Indian SOUs by combining quantitative NAAC outcomes with qualitative AQAR performance indicators. Employing seven key dimensions—including teaching-learning quality, student support, ICT adoption, regional outreach, governance, and affordability—the methodology yielded a highly reliable CR of 0.025, underscoring that institutional excellence requires a balanced performance across multiple criteria rather than relying on a single metric. The TOPSIS analysis ranked BAOU highest overall, followed by KSOU and UOU, while UPRTOU scored the lowest. Both academically and practically, this framework presents a transparent, reproducible, and evidence-based decision-support tool for institutional benchmarking, resource allocation, and quality assurance. While bounded by a discrete institutional sample, this research establishes an adaptable foundation that future

studies can scale by incorporating indicators like research productivity and longitudinal tracking to continuously guide higher education policy.

Ethical Approval and Declarations

Ethics Approval: Not applicable.

Consent to Participate: Not applicable.

Consent to Publish: Not applicable.

Competing interests: The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Funding Declaration: This research received no specific grant from any funding agency in the public, commercial, or non-profit sectors.

Data Availability: All data generated or analysed during this study are included in this published article.

REFERENCES

Alshamsi, A. M., El-Kassabi, H., Serhani, M. A., & Bouhaddioui, C. (2023). A multi-criteria decision-making (MCDM) approach for data-driven distance learning recommendations. *Education and Information Technologies, 28*(8), 10421–10458. https://doi.org/10.1007/s10639-023-11589-9

Behzadian, M., Otaghsara, S. K., Yazdani, M., & Ignatius, J. (2012). A state-of-the-art survey of TOPSIS applications. *Expert Systems with Applications, 39*(17), 13051–13069. https://doi.org/10.1016/j.eswa.2012.05.056

Benmoussa, N., Elyamami, A., Mansouri, K., Qbadou, M., & Illoussamen, E. (2019). A multi-criteria decision-making approach for enhancing university accreditation process. *Engineering, Technology & Applied Science Research, 9*(1). https://doi.org/10.48084/etasr.2352

Chakraborty, S. (2022). TOPSIS and modified TOPSIS: A comparative analysis. *Decision Analytics Journal, 2*, Article 100021. https://doi.org/10.1016/j.dajour.2021.100021

Chugh, R., Turnbull, D., Cowling, M. A., Vanderburg, R., & Vanderburg, M. A. (2023). Implementing educational technology in higher education institutions: A review of technologies, stakeholder perceptions, frameworks and metrics. *Education and Information Technologies, 28*(12), 16403–16429.

Department of Higher Education, Government of Uttarakhand. (n.d.). *NAAC accredited institutes.*

Dr. Babasaheb Ambedkar Open University. (2022). *NAAC grade sheet and certificate.*

Dr. Babasaheb Ambedkar Open University. (2024). *CIQA annual report 2023–24.*

Fernández, A., Gómez, B., Binjaku, K., & Meçe, E. K. (2023). Digital transformation initiatives in higher education institutions: A multivocal literature review. *Education and Information Technologies, 28*(10), 12351–12382.

Ghosh, C. (2022). Implementation of TOPSIS method to compare the libraries of top-ranking universities abroad and in India. *Journal of Information and Knowledge, 59*(2), 111–122. https://doi.org/10.17821/srels/2022/v59i2/166257

Gonda, M. G. (2014). Role of educational institutions in shaping the future of business and society. *Procedia Economics and Finance, 11*, 635–641. https://doi.org/10.1016/S2212-5671(14)00229-9

Hussain, A., Ullah, K., Ali, Z., Moslem, S., & Senapati, T. (2025). An enhanced physical education evaluation algorithm for higher education using interval valued Fermatean fuzzy information. *Socio-Economic Planning Sciences*, Article 102280. https://doi.org/10.1016/j.seps.2025.102280

Hwang, C. L., Lai, Y. J., & Liu, T. Y. (1993). A new approach for multiple objective decision making. *Computers & Operations Research, 20*(8), 889–899. https://doi.org/10.1016/0305-0548(93)90109-V

Hwang, C. L., & Yoon, K. (1981). Methods for multiple attribute decision making. In *Multiple attribute decision making: Methods and applications a state-of-the-art survey* (pp. 58–191). Springer. https://doi.org/10.1007/978-3-642-48318-9_3

Ibrahim, O., Sundgren, D., & Larsson, A. (2014). An integrated decision support system framework for strategic planning in higher education institutions. In *Joint International Conference on Group Decision and Negotiation* (pp. 237–245). Springer. https://doi.org/10.1007/978-3-319-07179-4_2

Joshi, B. P., Bhatt, A., Manu, M., Kumar, A., Pant, S., & Joshi, P. (2023). Ambiguous fuzzy averaging operator based decision-making approach with application to classification of renewable energy sources. In *2023 International Conference on Power Energy, Environment & Intelligent Control (PEEIC)* (pp. 197–202). IEEE. https://doi.org/10.1109/PEEIC59336.2023.10450757

Kabak, Ö., & Ervural, B. (2017). Multiple attribute group decision making: A generic conceptual framework and a classification scheme. *Knowledge-Based Systems, 123*, 13–30. https://doi.org/10.1016/j.knosys.2017.02.011

Karnataka State Open University. (2023). *NAAC certificate.*

Karnataka State Open University. (2024). *CIQA annual report 2023–24.*

Kumar, R. (2025). A comprehensive review of MCDM methods, applications, and emerging trends. *Decision Making Advances, 3*(1), 185–199. https://doi.org/10.31181/dma31202569

Ministry of Education, Government of India. (2020). *National education policy 2020.*

Ministry of Education, Government of India. (2024). *All India Survey on Higher Education (AISHE) 2021–22 final report.*

Misra, P. K., & Sabharwal, N. S. (2025). *India higher education report 2024.*

National Assessment and Accreditation Council. (n.d.). *Assessment and accreditation.*

National Assessment and Accreditation Council. (2019). *Manual for open universities.*

Odisha State Open University. (2024). *NAAC institutional grade sheet.*

Odisha State Open University. (2025). *CIQA annual report.*

Popham, W. J. (1997). What's wrong—and what's right—with rubrics. *Educational Leadership, 55*, 72–75.

Rawat, S. S., Naudiyal, A., & Khajuria, R. (2026). Archimedean T-norm based q-Rung orthopair fuzzy Hamy mean operator with ordinal priority weights. *Intelligent Systems Research and Applications Journal, 2*, 54–75. https://doi.org/10.59543/f7febg22

Rawat, S. S., Komal, Dincer, H., & Yüksel, S. (2023). A hybrid weighting method with a new score function for analyzing investment priorities in renewable energy. *Computers & Industrial Engineering, 185*, Article 109692. https://doi.org/10.1016/j.cie.2023.109692

Rehman, A. U., Ahmad, S. M., & Khan, M. I. (2024). School teachers' unions social justice approach in top-bottom decision-making process: A case study of school teachers' unions in Northern Pakistan. *International Journal of Educational Research, 127*, Article 102437. https://doi.org/10.1016/j.ijer.2024.102437

Roberts, J., & van der Walt, H. (2026). *Open and distance learning research trends in higher education: A systematic literature review of research in the Commonwealth from 2015 to 2024.* https://doi.org/10.56059/11599/6105

Saaty, T. L. (1980). *The analytic hierarchy process: Planning, priority setting, resource allocation.* McGraw-Hill.

Saaty, T. L. (1990). How to make a decision: The analytic hierarchy process. *European Journal of Operational Research, 48*(1), 9–26. https://doi.org/10.1016/0377-2217(90)90057-I

Shinto, K. G., & IQAC Coordinator. (2025). *AQAR 2023–24.*

Srivastava, S., Tripathi, A., & Arora, N. (2024). Multi-criteria decision making (MCDM) in diverse domains of education: A comprehensive bibliometric analysis for research directions. *International Journal of System Assurance Engineering and Management*, 1–18. https://doi.org/10.1007/s13198-024-02332-9

Tamil Nadu Open University. (2023). *NAAC grade sheet.*

Tamil Nadu Open University. (2024). *CIQA annual report 2023–24.*

Thakur, S. S. (2026). IQAC-led institutional quality assurance initiatives during the NAAC AQAR transitional year (2024–25). *International Journal of Academic Research, 12*(1), 38–48.

Tonbuloğlu, B. (2024). Determining a framework for institutional support of instructors engaged in distance education programmes using the multiple-criteria decision-making method. *International Review of Education, 70*(1), 111–141. https://doi.org/10.1007/s11159-023-10045-7

Triantaphyllou, E. (2000). Multi-criteria decision making methods. In *Multi-criteria decision making methods: A comparative study* (pp. 5–21). Springer. https://doi.org/10.1007/978-1-4757-3157-6_2

University Grants Commission. (n.d.). *Distance Education Bureau.*

Uttar Pradesh Rajarshi Tandon Open University. (2023). *NAAC grade sheet.*

Uttar Pradesh Rajarshi Tandon Open University. (2024). *AQAR 2023–24.*

Uttarakhand Open University. (2024). *Annual quality assurance report 2023–24.*

Vardhaman Mahaveer Open University. (2023). *NAAC certificate.*

Vardhaman Mahaveer Open University. (2024). *CIQA report 2023–24.*

Yashwantrao Chavan Maharashtra Open University. (2022). *NAAC certificate and grade sheet.*

Yashwantrao Chavan Maharashtra Open University. (2024). *AQAR 2023–24.*

Yoon, K. (1987). A reconciliation among discrete compromise solutions. *Journal of the Operational Research Society, 38*(3), 277–286. https://doi.org/10.1057/jors.1987.44