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Triangular Offnorm with Multi-Criteria Decision-Making Method for College Political and Ideological Instruction on Intelligent Learning Platforms

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Abstract: Traditional teaching has been transformed by the introduction of intelligent learning platforms into higher education, especially in political and ideological education. By determining important evaluative criteria and evaluating different instructional options in smart learning settings, this study seeks to investigate the efficacy and quality of such training. The study creates a balanced set of indicators in line with learner outcomes, technology engagement, and pedagogical goals using a systematic multicriteria decision-making (MCDM) framework. For political and ideological courses offered via intelligent platforms, the objective is to offer practical insights that can improve policy implementation and instructional design. We use the RATGOS methodology to rank alternatives. We use eight criteria and six alternatives in this paper. We use the Triangular OffNorm to deal with different decision values in the decision-making process. The ranks of alternatives are tested by sensitivity analysis. The results show the ranks of alternatives are stable in different cases.

Keywords: Triangular OffNorm; Multicriteria Decision-Making (MCDM); Political and Ideological.

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1. Introduction

Intelligent learning platforms have become a key element in higher education, and the emergence of digital education tools has drastically changed the educational environment. These systems provide data-driven content distribution, adaptive feedback, and tailored learning experiences[1].

Adapting to this digital transformation presents both new possibilities and problems for political and ideological education, which is a fundamental component of character and civic development in many university curriculums. For students who are digital natives, traditional approaches might not be enough to hold their interest and satisfy their needs[2], [3].

To maintain educational integrity and learning results, the efficacy of political and ideological training must be regularly evaluated as universities depend more and more on intelligent learning platforms. Using a variety of factors, such as engagement tactics, content relevancy, technical functionality, and cognitive development measures, this study creates a strong evaluation model. These standards offer a thorough understanding of the advantages and disadvantages of teaching on intelligent platforms[4], [5].

Several instructional options are investigated to support practical assessment, including gamified learning, AI tutors, multimedia-rich modules, and real-time discussion forums. Each of these options has unique pedagogical advantages and disadvantages[6], [7].

The methodology ranks and examines these options according to how well they meet the predetermined criteria using a multicriteria decision-making approach. This makes it possible to determine which strategies best assist political and ideological education using data-driven analysis. The ultimate purpose of this research is to assist platform developers, educators, and policymakers in maximizing instructional tactics that appeal to students in the digital age while also being in line with educational objectives[8], [9].

1.1 Digital Education

A variety of hardware tools, media, scientific research staff, instructional materials, and other resources are all considered educational resources. Information, human, and other resources are examples of material resources. One way to process educational materials digitally is through digital resources[10], [11].

Details The creation of educational activities with an informational backdrop is known as instructional design. Through sensible planning and scientific teaching organization, it offers pupils an accurate, effective, high-quality, and appropriate learning environment. To properly categorize, incorporate, and utilize them, teachers should actively gather and separate important and often used web resources as well as remove duplicate content. Lastly, free, excellent Ideological and Political Education resources ought to be included[12], [13].

Building a library of digital teaching resources that satisfies the requirements of instructional practice:
First and foremost, the demands of both teachers and students should actively shape and broaden the meaning of instructional materials. Teachers and students are the target audience for the digital education teaching resource platform. To ensure a smooth relationship between supply and demand, the various demands of teachers and students should be fully considered while creating digital teaching resources. Additionally, the resource information should be categorized sensibly and scientifically. Simultaneously, the features of education must also be represented[14], [15].

The platform of educational digital teaching materials should be constructed using various teaching resource libraries. At the same time, a public teaching resource library must be established to accomplish the integration and sharing of Ideological and Political Education and to set the groundwork for resource sharing.

1.2 MCDM Approach

The difficulties in assessing Ideological and Political Education are complex and frequently stem from the intricacy of multi-criteria decision-making (MCDM), as well as the decision-making process's paradoxical phenomena and data limitations. Different decision-making preferences, viewpoints, and professional expertise are all part of MCDM. It can be quite difficult to incorporate this data into a coherent framework. Furthermore, certain decision-makers' unique data may result in deadly paradoxical occurrences and poor decision-making due to data restrictions for decision-making techniques[16], [17].

Since Ideological and Political Education should be evaluated based on their criteria, we propose in this paper to create a complex procedure for evaluating Ideological and Political Education and choosing suitable Ideological and Political Education as an MCDM issue. To solve these problems, we create an MCDM approach to rank Ideological and Political Education using the Triangular OffNorm as the data background[18].

The main contributions of this study are summarized as:

(1) The decision-making outcomes of MCDM techniques are significantly impacted by the similarity measure. We present a Triangular OffNorm to deal with different decision matrix.

(2) The decision-making outcomes of MCDM techniques are also significantly impacted by the score function.

(3) We obtain the weights of the criteria by the average method in the decision matrix between the criteria and alternatives.

(4) The alternatives are ranked using the RATGOS method.

(5) The sensitivity analysis is conducted with ten cases. The results show the ranks of alternatives are stable in different cases.

2. Proposed Approach

Triangular OffNorm (t-offnorm)[19]

$T_{offNorm}: [\sigma, \rho] \times [\sigma, \rho] \to [\sigma, \rho], \sigma < 0 < 1 < \rho$ (1)

So that, for all $(A, B) \in [\sigma, \rho] \times [\sigma, \rho]$ (2)

$T_{offNorm}(A, B) = T_{offNorm}(B, A)$ commutativity (3)

$T_{offNorm}\left(A, T_{offNorm}(B, C)\right) = T_{offNorm}\left(T_{offNorm}(A, B), C\right)$, associativity (4)

$if\ B \leq C, then\ T_{offNorm}(A, B) \leq T_{offNorm}(A, C)$, monotonicity (5)

$T_{offNorm}(A, \rho) = A$, or the neutral component is ρ (the largest one) (6)

Instance of Triangular OffNorm (t-offnorm)

$T_{offNorm}(A, B) = \min(A, B)$, which is the extended Gödel t-norm from the unitary interval [0, 1] to the non-unitary interval $[\sigma, \rho]$ for $\sigma < 0 < 1 < \rho$.

We show the steps of the RATGOS method to rank the alternatives.

Create the decision matrix between the criteria and the alternatives. We use the $T_{offNorm}$ to combine the decision matrix into a singe matrix.

Compute the criteria weights.

Obtain the optimal value for positive and negative criteria

$$A_j = \max y_j \quad (7)$$

$$A_j = \max 1/y_j \quad (8)$$

Obtain the normalized values for positive and negative factors.

$$B = \frac{y_{ij}}{A_j} \quad (9)$$

$$B = \frac{A_j}{y_{ij}} \quad (10)$$

Obtain the weighted decision matrix

$$H_{ij} = W_j B \quad (11)$$

Obtain the geometric mean.

Rank the alternatives.

3. Findings

This section shows the results of the proposed approach to obtaining the criteria weights and ranking the alternatives. The criteria of this study are:

- Content relevance is the degree to which educational materials are in line with the ideological and political objectives of the curriculum.
- Encouragement of critical thought, introspection, and analysis is known as cognitive engagement.
- Technological Usability: Platform accessibility and ease of use.
- Adaptability and feedback quality based on student data are known as learning analytics.
- Interactivity: The involvement of students in debates, peer cooperation, and quizzes.
- Using audio, video, and infographics to improve learning is known as multimedia integration.

- o Respect for moral principles and ideological variety is a sign of cultural and ethical sensitivity.
- o Instructor Support: How often and to what extent do teachers participate on the platform?
- o Mechanisms of Assessment: Suitability and efficacy of assessment instruments.
- o Student satisfaction refers to how students feel about the experience and worth of the course.

The alternatives of this study are:

- ✓ AI-Powered Adaptive Learning Modules
- ✓ Multimedia-Rich Video Lectures
- ✓ Gamified Ideological Learning Systems
- ✓ Virtual Debate and Discussion Forums
- ✓ Case-Based Interactive Scenarios
- ✓ Blended Learning with Online and Offline Components

We show the results of the proposed approach.

Three experts have created the decision matrix between the criteria and alternatives as shown in Table 1. These values are combined using the $T_{offNorm}$.

We obtain the criteria weights. C1=0.087209302 C2=0.075581395 C3=0.104651163 C4=0.104651163 C5=0.104651163 C6=0.081395349 C7=0.151162791 C8=0.069767442 C9=0.098837209 C=100.122093023.

The listed weights represent the relative importance of ten distinct evaluation criteria (labeled C1 to C10) used in an MCDM framework. Each weight indicates how much influence or significance a particular criterion holds in the overall assessment. These weights are typically used in contexts such as performance evaluation, system analysis, or decision optimization.

The most influential criterion is C7 (15.12%), which likely represents a strategic factor or priority in the system being evaluated.

The least influential is C8 (6.98%), indicating a lower impact on overall evaluation.

Criteria C3, C4, and C5 share equal importance, highlighting a consistent evaluation focus across multiple aspects.

The total weight (excluding the typo for "C=100.122093023") correctly sums up to 1.0, ensuring that the criteria weights are properly normalized for MCDM applications.

Table 1. The decision matrix.

	C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9	C_{10}
A_1	[0.2,0.3]	[0.3,0.4]	[0.4,0.5]	[0.5,0.6]	[0.6,0.7]	[0.7,0.8]	[0.6,0.7]	[0.6,0.7]	[0.2,0.3]	[0.6,0.7]
A_2	[0.7,0.8]	[0.1,0.2]	[0.2,0.3]	[0.3,0.4]	[0.4,0.5]	[0.5,0.6]	[0.5,0.6]	[0.2,0.3]	[0.3,0.4]	[0.5,0.6]
A_3	[0.6,0.7]	[0.1,0.2]	[0.4,0.5]	[0.5,0.6]	[0.6,0.7]	[0.6,0.7]	[0.4,0.5]	[0.1,0.2]	[0.4,0.5]	[0.4,0.5]

A_4	[0.5,0.6]	[0.2,0.3]	[0.3,0.4]	[0.2,0.3]	[0.1,0.2]	[0.2,0.3]	[0.3,0.4]	[0.5,0.6]	[0.5,0.6]	[0.3,0.4]
A_5	[0.4,0.5]	[0.1,0.2]	[0.5,0.6]	[0.6,0.7]	[0.7,0.8]	[0.6,0.7]	[0.7,0.8]	[0.4,0.5]	[0.1,0.2]	[0.7,0.8]
A_6	[0.3,0.4]	[0.5,0.6]	[0.4,0.5]	[0.2,0.3]	[0.7,0.8]	[0.2,0.3]	[0.6,0.7]	[0.3,0.4]	[0.2,0.3]	[0.6,0.7]
	C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9	C_{10}
A_1	[0.1,0.2]	[0.3,0.4]	[0.4,0.5]	[0.5,0.6]	[0.6,0.7]	[0.2,0.3]	[0.6,0.7]	[0.1,0.2]	[0.7,0.8]	[0.6,0.7]
A_2	[0.2,0.3]	[0.6,0.7]	[0.2,0.3]	[0.3,0.4]	[0.4,0.5]	[0.5,0.6]	[0.5,0.6]	[0.1,0.2]	[0.3,0.4]	[0.5,0.6]
A_3	[0.3,0.4]	[0.6,0.7]	[0.4,0.5]	[0.5,0.6]	[0.6,0.7]	[0.1,0.2]	[0.5,0.6]	[0.5,0.6]	[0.4,0.5]	[0.5,0.6]
A_4	[0.4,0.5]	[0.2,0.3]	[0.3,0.4]	[0.7,0.8]	[0.1,0.2]	[0.7,0.8]	[0.3,0.4]	[0.4,0.5]	[0.5,0.6]	[0.3,0.4]
A_5	[0.5,0.6]	[0.6,0.7]	[0.5,0.6]	[0.1,0.2]	[0.2,0.3]	[0.3,0.4]	[0.7,0.8]	[0.3,0.4]	[0.1,0.2]	[0.2,0.3]
A_6	[0.3,0.4]	[0.7,0.8]	[0.1,0.2]	[0.2,0.3]	[0.3,0.4]	[0.4,0.5]	[0.6,0.7]	[0.2,0.3]	[0.2,0.3]	[0.6,0.7]
	C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9	C_{10}
A_1	[0.7,0.8]	[0.3,0.4]	[0.4,0.5]	[0.5,0.6]	[0.5,0.6]	[0.2,0.3]	[0.6,0.7]	[0.6,0.7]	[0.2,0.3]	[0.1,0.2]
A_2	[0.7,0.8]	[0.5,0.6]	[0.2,0.3]	[0.3,0.4]	[0.4,0.5]	[0.5,0.6]	[0.5,0.6]	[0.2,0.3]	[0.3,0.4]	[0.5,0.6]
A_3	[0.1,0.2]	[0.4,0.5]	[0.4,0.5]	[0.5,0.6]	[0.3,0.4]	[0.4,0.5]	[0.4,0.5]	[0.6,0.7]	[0.4,0.5]	[0.4,0.5]
A_4	[0.5,0.6]	[0.3,0.4]	[0.5,0.6]	[0.2,0.3]	[0.2,0.3]	[0.3,0.4]	[0.3,0.4]	[0.5,0.6]	[0.5,0.6]	[0.3,0.4]
A_5	[0.4,0.5]	[0.7,0.8]	[0.4,0.5]	[0.5,0.6]	[0.5,0.6]	[0.2,0.3]	[0.2,0.3]	[0.4,0.5]	[0.6,0.7]	[0.2,0.3]
A_6	[0.3,0.4]	[0.5,0.6]	[0.3,0.4]	[0.4,0.5]	[0.4,0.5]	[0.5,0.6]	[0.6,0.7]	[0.3,0.4]	[0.6,0.7]	[0.6,0.7]

Eqs. (7 and 8) are used to obtain the optimal value for positive and negative criteria as shown in Fig 1.

Eqs. (9 and 10) are used to obtain the normalized values for positive and negative factors as shown in Fig 2.

Eq. (11) is used to obtain the weighted decision matrix as shown in Fig 3.

We obtain the geometric mean. We rank the alternatives as shown in Fig 4.

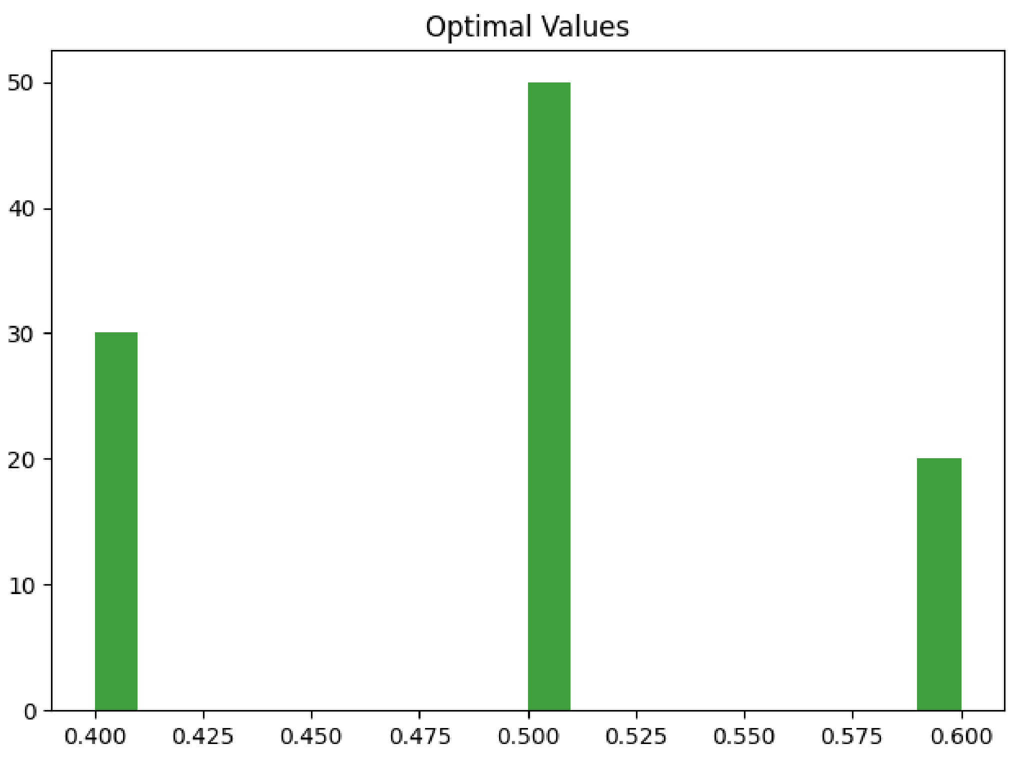

Fig 1. The Optimal value.

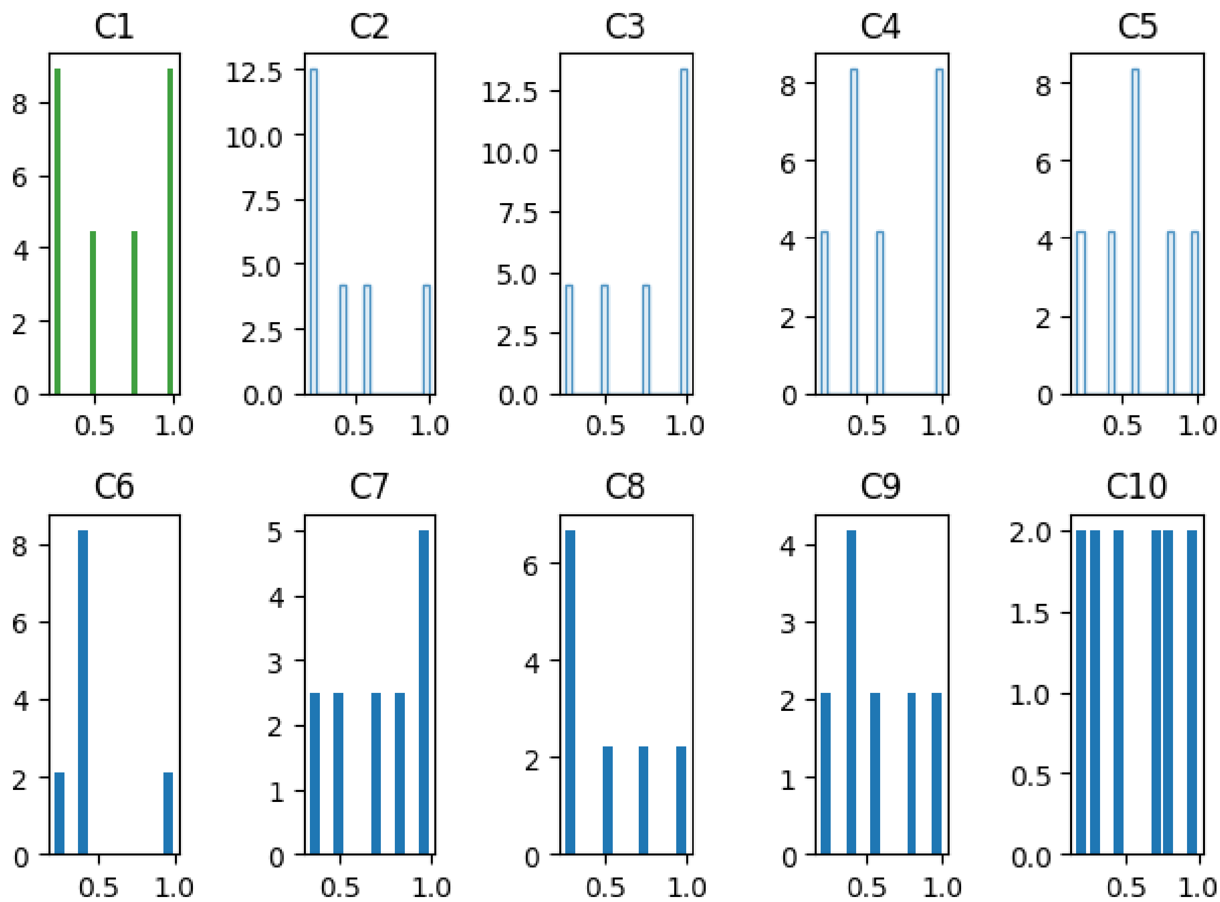

Fig 2. The normalized values.

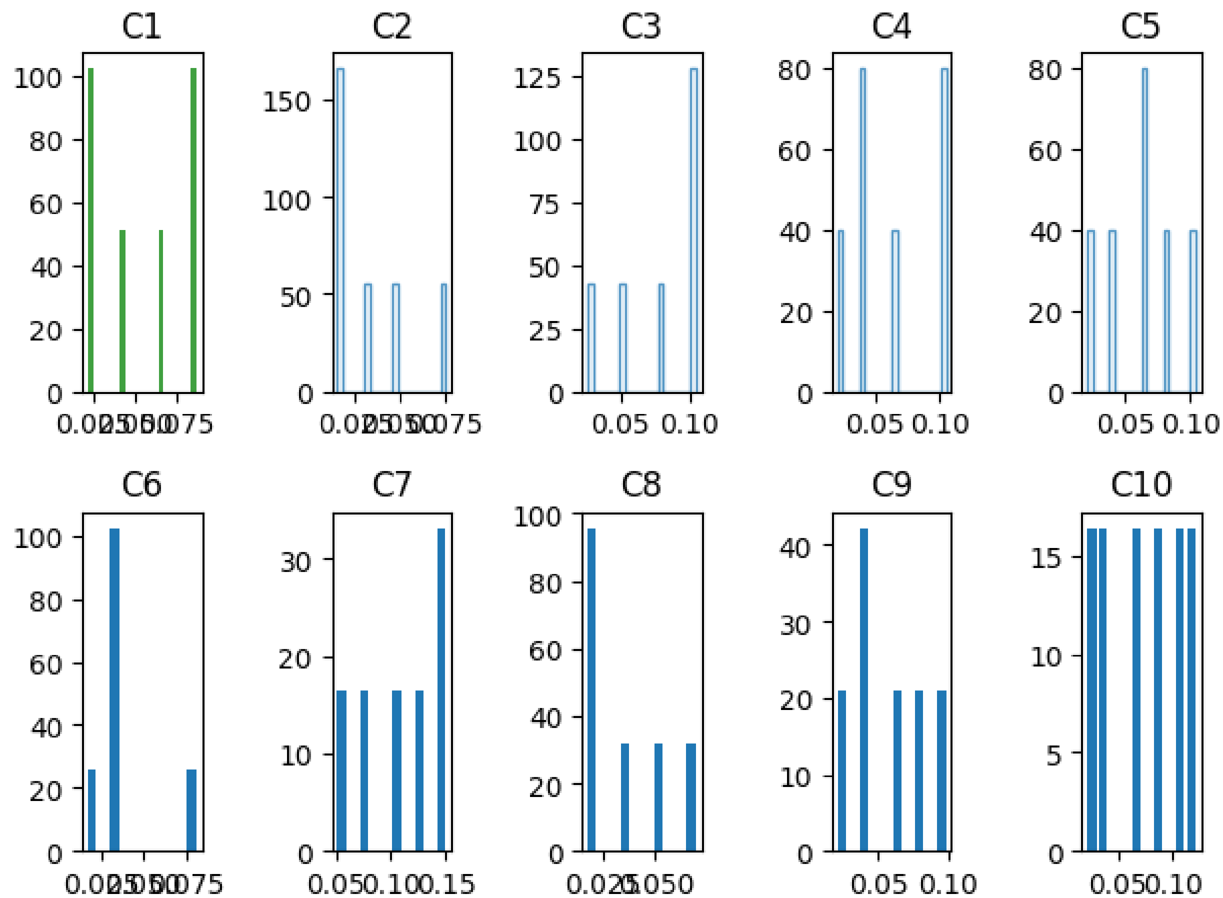

Fig 3. The weighted decision matrix.

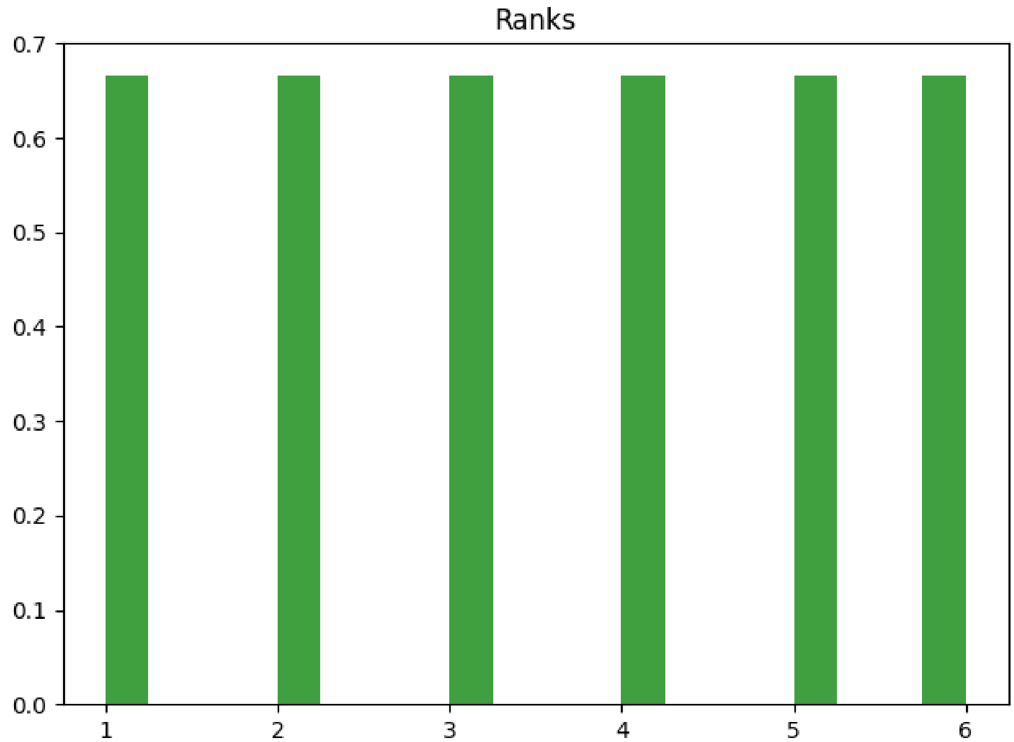

Fig 4. The rank of alternatives.

A5 is the highest-ranked alternative, indicating it performs best overall based on the evaluation criteria. It likely excels in most or all dimensions considered.

A3 is the second-highest performer, showing strong results, though slightly behind P5 in overall performance.

A1 ranks mid-high, indicating moderate to good performance across the evaluation metrics.

A4 is in the middle of the ranking, suggesting average performance. It neither excels nor underperforms.

A2 ranks low, meaning it performs worse than most other alternatives, with notable areas needing improvement.

A6 is the lowest-ranked alternative, indicating poor overall performance compared to the others. It may lack strength in several key criteria

4. Sensitivity Analysis

This section shows the results of the sensitivity analysis. We change the criteria weights by ten cases with 10% increase of weights as shown in Fig 5. Fig 6 shows the score of each alternative.

Then we ranked the alternatives as shown in Fig 7. The results show the ranks of alternatives are stable under different criteria.

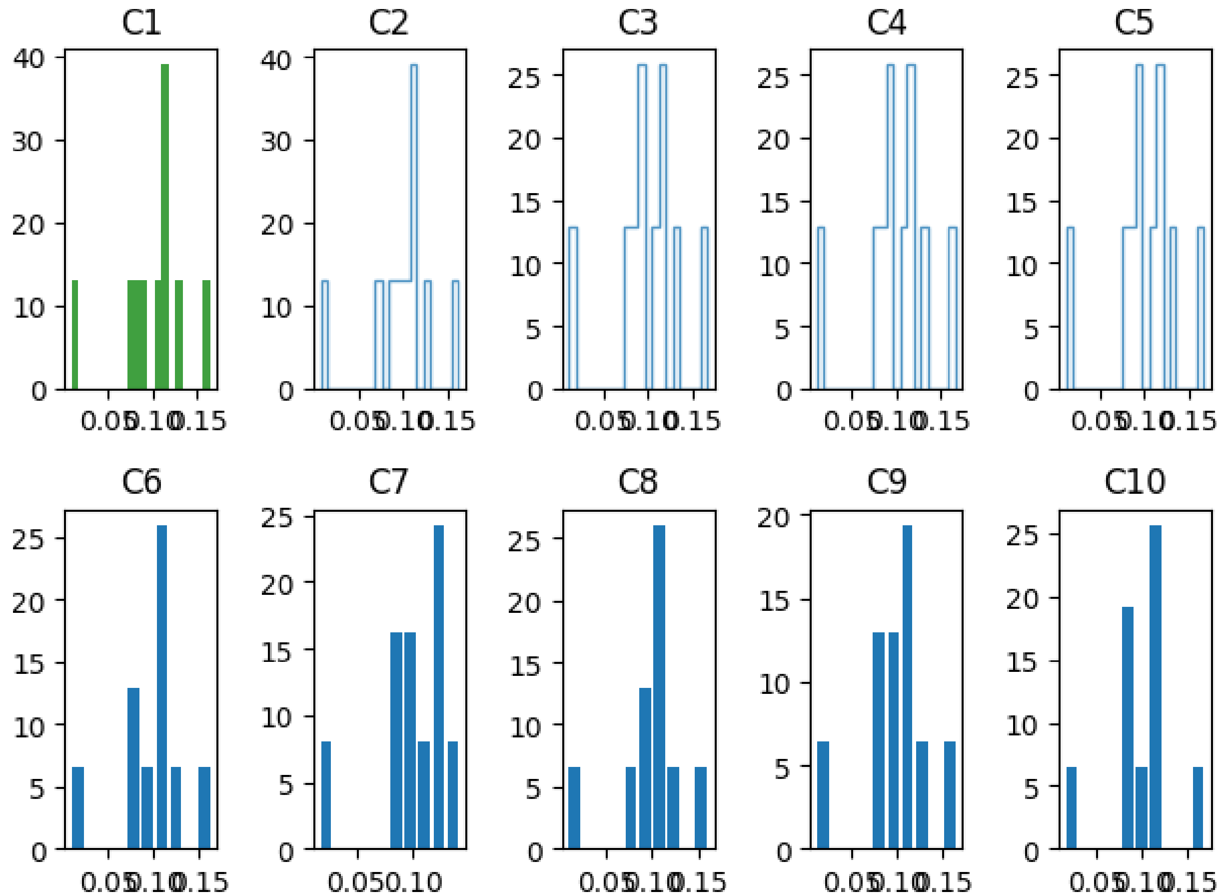

Fig 5. The ten cases of criteria weights.

Each (C1 to C10) represents a criterion, and each (Case 1 to Case 10) represents a different weighting scenario or sensitivity case. The values in the table are normalized weights (summing to ~1 per case), indicating the relative importance of each criterion within that case.

- C1 (Criterion 1):
  - Weight range: 0.0095 to 0.1009
  - Low in Case 1 (least influential), highest in Case 7.
  - Shows high variability; its importance fluctuates significantly.
- C2 (Criterion 2):
  - Weight range: 0.0081 to 0.0875

- Lowest in Case 2, highest in Case 7.
- Generally lower-weighted, but plays a more prominent role in Case 7.

- C3 (Criterion 3):
  - Weight range: 0.0116 to 0.1211
  - Lowest in Case 3 (almost negligible), highest in Case 7.
  - Central to the analysis in most cases, except Case 3.
- C4 (Criterion 4):
  - Weight range: 0.0116 to 0.1211
  - Very similar behavior to C3.
  - Minimal in Case 4, crucial in Case 7.
- C5 (Criterion 5):
  - Weight range: 0.0116 to 0.1211
  - Important in all cases except Case 5.
  - Its role flips completely in Case 5 where it becomes the least significant.
- C6 (Criterion 6):
  - Weight range: 0.0088 to 0.0942
  - Lowest in Case 6, showing it's minimally important there.
  - Slightly more consistent across other cases, with moderate influence.
- C7 (Criterion 7):
  - Weight range: 0.0175 to 0.1698
  - Dominant in most cases except Case 7, where it sharply drops.
  - Typically a key driver in the decision process.
- C8 (Criterion 8):
  - Weight range: 0.0074 to 0.0808
  - Very low in Case 8, more significant in Case 7.
  - Generally less important, except for some spikes.
- C9 (Criterion 9):

- Weight range: 0.0108 to 0.1144
- Dips in Case 9, highest in Case 7.
- Moderate importance overall with a few highs/lows.

- C10 (Criterion 10):
  - Weight range: 0.0137 to 0.1413
  - Very low in Case 10, strong impact in most others.
  - It tends to be consistently significant.
- Case 7 tends to assign highest weights to most criteria, indicating a scenario where influence is spread more strongly across several dimensions.
- Cases 1–3 include sharply minimized weights for one or more criteria, possibly for stress-testing or sensitivity analysis.
- The variation in values suggests robust sensitivity testing where the importance of each criterion is rotated to evaluate its effect on outcomes

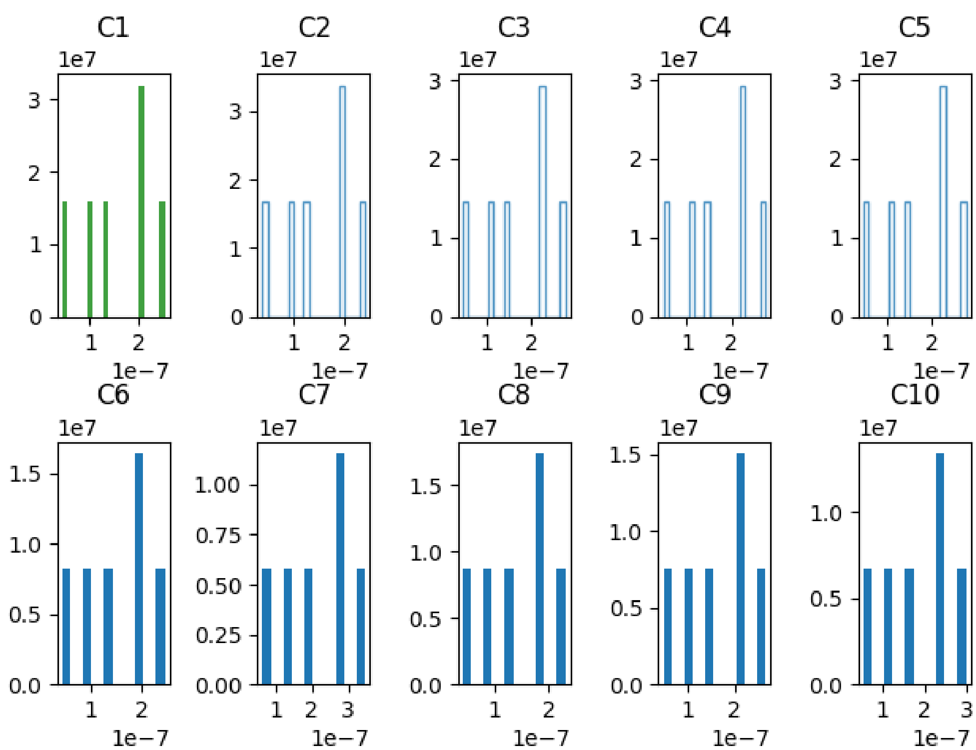

Fig 6. The ten cases of score of alternatives.

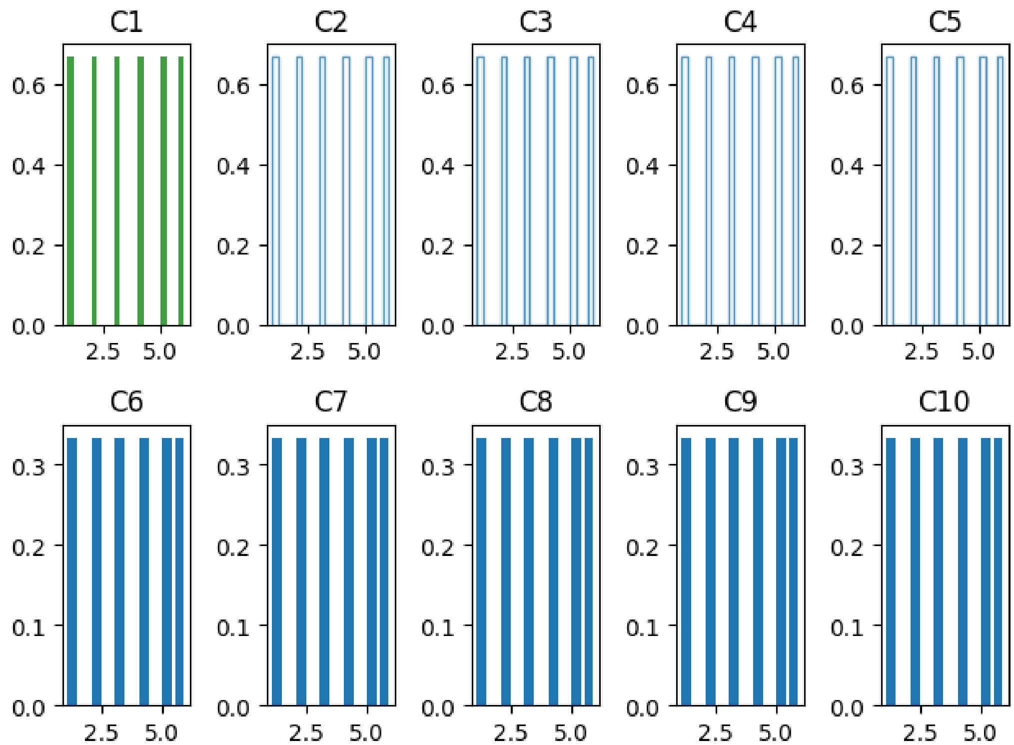

Fig 7. The ten cases of ranks of alternatives.

5. Conclusions

The evaluation of Political and Ideological instruction through intelligent platforms reveals a multifaceted and evolving educational environment. By applying a systematic set of criteria to assess various instructional approaches, this study highlights the need for pedagogical adaptability and digital fluency among educators. We use the MCDM approach in this study. We obtain the criteria weights by the average method. The alternatives are ranked using the RATGOS method. The sensitivity analysis is conducted to show the stability of the ranks. We made the sensitive analysis with ten cases in criteria weights. The results show the ranks of alternatives are stable under different Cass.

The findings underscore the importance of combining content integrity with technological innovation to achieve effective ideological education in universities. The outcomes not only guide future curriculum development but also encourage the strategic use of intelligent systems to foster well-rounded, critically thinking students.

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References

[1] H. Li, "Multicultural data assistance mining analysis for ideological and political education in smart education platforms using artificial intelligence," *Wirel. Networks*, vol. 31, no. 1, pp. 567–581, 2025.

[2] N. Hong and X. Liu, "Design of an IoT-Based Intelligent Platform for Ideological and Political Education Management," *Int. J. High Speed Electron. Syst.*, p. 2540281, 2025.

[3] F. Dong and S. Dong, "Research on the optimization of ideological and political education in universities integrating artificial intelligence technology under the guidance of curriculum ideological and political thinking," *ACM Trans. Asian Low-Resource Lang. Inf. Process.*, 2023.

[4] S. Zhengjuan, "Innovative Research on Ideological and Political Education Models for University Students Based on Artificial Intelligence," *Int. J. Soc. Sci. Univ.*, p. 43.

[5] H. Li and X. Dong, "Construction of Online Ideological and Political Education Platform Based on Artificial Intelligence Technology," in *International Conference on E-Learning, E-Education, and Online Training*, Springer, 2022, pp. 129–144.

[6] M. Li, "Intelligent Platform of Ideological and Political Education Resources under Digital Education Environment [J]," *Adv. Educ. Technol. Psychol.*, vol. 8, no. 1, 2024.

[7] G. Yun, R. V Ravi, and A. K. Jumani, "Analysis of the teaching quality on deep learning-based innovative ideological political education platform," *Prog. Artif. Intell.*, vol. 12, no. 2, pp. 175–186, 2023.

[8] P. Huang, "Research on Personalized Ideological and Political Education Content Distribution System Based on Intelligent Algorithms," *Int. J. High Speed Electron. Syst.*, p. 2540151, 2024.

[9] H. Yang, "E-learning platforms in ideological and political education at universities: students' motivation and learning performance," *BMC Med. Educ.*, vol. 24, no. 1, p. 628, 2024.

[10] E. P. Arruda, S. dos Santos Gomes, and D. P. Arruda, "Digital education in Germany: Policies, teacher perspectives, and challenges in a post-pandemic world," in *Forum for Education Studies*, 2025, p. 1976.

[11] Q. Huang, C. Lv, L. Lu, and S. Tu, "Evaluating the Quality of AI-Generated Digital Educational Resources for University Teaching and Learning," *Systems*, vol. 13, no. 3, p.

174, 2025.

[12] S. Sheehan *et al.*, “Digital education in healthcare: A mixed methods evaluation of the advanced breast cancer for nurses (ABC4Nurses) eLearning programme,” *Nurse Educ. Today*, vol. 146, p. 106533, 2025.

[13] D. R. Novitasari and R. Darmayanti, “Exploring Differentiated Learning with Wordwall and Salon Rambutku Digital Education Tools,” *JAMBORE J. Anal. Sist. Probl. Dan Perubahan Pendidik.*, vol. 1, no. 1, 2025.

[14] O. Zawacki-Richter, B. Cefa, and J. Y. H. Bai, “Towards reproducible systematic reviews in Open, Distance, and Digital Education—An umbrella mapping review,” *Rev. Educ.*, vol. 13, no. 1, p. e70031, 2025.

[15] F. Makda, “Digital education: Mapping the landscape of virtual teaching in higher education–a bibliometric review,” *Educ. Inf. Technol.*, vol. 30, no. 2, pp. 2547–2575, 2025.

[16] X. Peng, L. Yu, and X. Wu, “q-Rung orthopair fuzzy multi-criteria decision-making method for Internet of Things platforms selection,” *Eng. Appl. Artif. Intell.*, vol. 148, p. 110336, 2025.

[17] Z.-F. Hou, K.-M. Lee, K.-L. Keung, and J.-Y. Huang, “A Novel Multi-Criteria Decision-Making Framework of Vehicle Structural Factor Evaluation for Public Transportation Safety,” *Appl. Sci.*, vol. 15, no. 6, p. 3045, 2025.

[18] Z. Tamer, G. Demir, S. Darıcı, and D. Pamučar, “Understanding twitter in crisis: a roadmap for public sector decision makers with multi-criteria decision making,” *Environ. Dev. Sustain.*, pp. 1–37, 2025.

[19] F. Smarandache, *Operators for Uncertain Over/Under/Off-Sets/-Logics/-Probabilities/-Statistics*. Infinite Study, 2025.

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