Neutrosophic Sets and Systems, Vol. 85, 2025

University of New Mexico

Double Framed HyperSoft Set for Studies Factors That Influence and Ways to Improve Vocational College Instruction in Innovation and Entrepreneurship

Minyan Chen*

School of Continuing Education, Hefei Technology College, Hefei, Anhui, 238010, China

*Corresponding author, E-mail: c1006662025@163.com

Abstract: This study explores the multifaceted dimensions of vocational college instruction in innovation and entrepreneurship. With global economies increasingly relying on innovation as a driver of growth, higher education institutions are called upon to cultivate entrepreneurial mindsets among students. The study identifies and evaluates eight key criteria affecting instructional effectiveness and compares eight instructional strategies (alternatives) using a structured decision-making approach. The methodology integrates both quantitative and qualitative perspectives, ensuring a robust framework for analyzing instructional impact. The MOORA method is used to rank alternatives based on a set of criteria. The Double Framed HyperSoft Set (DFHS) is used to deal with the criteria values by using double framed. The findings highlight which strategies yield the most effective outcomes in fostering innovation-oriented competencies. Results can guide vocational colleges in tailoring their curricula, teaching methods, and institutional support systems to nurture the next generation of entrepreneurs. The research also proposes practical recommendations for enhancing vocational college-based entrepreneurship instruction aligned with the best global practices and student need.

Keywords: Double Framed HyperSoft Set; Vocational college Instruction; Innovation and Entrepreneurship.

1. Introduction

Vocational colleges all around the world have realized in recent years how important it is to equip students with both academic knowledge and real-world skills for the quickly changing workplace. Since they give students the skills and mindset to think creatively, solve challenging problems, and support economic growth, innovation and entrepreneurship have become essential parts of higher education curricula[1], [2]. One of the most important ways to make sure students are prepared to handle the opportunities and difficulties of the global economy is to incorporate innovation and entrepreneurship into vocational college curricula.

One of the main ways that students can be introduced to the concepts of innovation and entrepreneurship is through vocational college instruction. Students' capacity to think critically, investigate novel ideas, and cultivate entrepreneurial abilities is significantly impacted by the way these subjects are taught[3], [4]. However, there is still a big disconnect between the theoretical information taught in classrooms and the real-world application of that knowledge, even with the increased focus on entrepreneurship in higher education.

How well vocational colleges can teach innovation, and entrepreneurship depends on several factors. These elements include the faculty members' degree of experience and skill, the availability of tools like accelerators and incubators, the general culture of the school, and the backing of business partners[5], [6]. Furthermore, the teaching strategies employed—whether they include practical projects, case studies, or internships—are crucial in closing the knowledge gap between theory and practice. Gaining an understanding of these elements is essential to enhancing vocational college instruction in entrepreneurship and innovation.

The faculty's experience is one of the most important elements in determining how well innovation and entrepreneurship education is shaped. Professors with real-world entrepreneurial or innovative expertise can offer students insightful advice and insights that go beyond conventional academic knowledge[7], [8]. Additionally, faculty development initiatives that focus on enhancing professors' teaching abilities can raise the standard of instruction. The learning experience for students can be greatly improved by making sure that teachers are knowledgeable on both the academic and practical facets of innovation.

The infrastructure and resources required for innovation and entrepreneurship education must be provided by institutions. This includes tangible resources like innovation laboratories, financial support for student-run businesses, and collaborations with professionals in the field who can serve as mentors for students[9], [10]. It's also critical to establish a culture that promotes creativity, risk-taking, and teamwork. Since innovation frequently happens at the nexus of various fields, vocational colleges must also create conditions that stimulate multidisciplinary collaboration.

Student learning outcomes can be significantly impacted by the teaching strategies used in vocational college courses on entrepreneurship and innovation. It's possible that conventional lecture-based methods are insufficient to promote creativity and problem-solving abilities. Project-based learning, experiential learning, and cooperative cooperation might be more successful tactics[11], [12]. These methods assist students in gaining real-world experience, interacting with real-world problems, and comprehending how to use creative thinking in a variety of settings.

Stronger industry-academia cooperation is required to increase the relevance of vocational college education. Vocational colleges can give students access to mentorship, internships, and practical projects that mimic real-world difficulties by collaborating with companies, startups, and other groups. These collaborations further close the gap between education and practice by exposing students to the newest trends, technology, and business difficulties in addition to helping them obtain real-world experience.

Vocational colleges must modify their teaching methods to stay up with the rapidly changing landscape of innovation and entrepreneurship[13], [14]. A static curriculum is insufficient; academic institutions must constantly evaluate and enhance their teaching strategies. Vocational colleges can improve their teaching strategies, make sure they are addressing the needs of their students, and foster the next generation of creative thinkers and entrepreneurs by routinely collecting input from students, faculty, and industry partners.

Criteria weighing plays a vital role in multi-criteria decision making (MCDM) processes, influencing the selection of optimal alternatives. Criteria weights are assigned using various weighting techniques[15], [16]. These techniques ensure a thorough assessment of the options by assisting in identifying the importance of each criterion in the decision-making process. Accurate and trustworthy decision outcomes depend on the proper estimation of criteria weights, particularly in situations where there are several criteria. Inaccurate weights may cause decisions to be less than ideal, possibly ignoring crucial aspects or placing too much emphasis on less significant ones[17], [18]. Because criterion weighting heavily relies on subjective expert assessments, one of the primary issues is the subjectivity involved in weight assignment, which can induce bias and inconsistency.

This reliance may compromise the soundness of the decisions by producing different results depending on the opinions and experiences of the experts. These techniques can also be laborious and time-consuming, involving a great deal of data collecting and analysis. Decision-makers may be discouraged by this complexity from carefully examining all pertinent factors or from revising weights considering fresh information[19], [20]. As a result, choices based on out-of-date or insufficient information may not adequately address pressing issues. All these issues have the potential to greatly affect the results of decisions, especially in domains where accuracy and dependability are essential.

Smarandache presented six new categories of soft sets, including the HyperSoft Set (2018), TreeSoft Set (2022), ForestSoft Set (2024), IndetermSoft Set (2022), IndetermHyperSoft Set (2022), and SuperHyperSoft Set[21], [22], [23].

2. Double Framed HyperSoft Set (DFHS)

The definitions of the DFHS are shown in this section.

Let U be a universal set and P(U) is the powerset of U. Let set of criteria $c_1, c_2, \dots, c_n; n \geq 1$ and the values of crietria $a_1, a_2, \dots, a_n$ $and\ a_i \cap a_j = \emptyset\ for\ i \neq j$

Then the pair $(\omega_1, \omega_2), a_1 \times a_2 \times \ldots \times a_n$ the ω_1, ω_2 are mapping from $a_1 \times a_2 \times \ldots \times a_n \rightarrow P(U)$ [24]

Example

Let set of alternatives A_1, A_2, A_3, A_4 and set of criteria with values such as:

$$C_1 = \{c_{11}, c_{12}, c_{13}, c_{14}\} \quad (1)$$

$$C_2 = \{c_{21}, c_{22}, c_{23}, c_{24}\} \quad (2)$$

$$C_3 = \{c_{31}, c_{32}, c_{33}, c_{34}\} \quad (3)$$

$$C_4 = \{c_{41}, c_{42}, c_{43}, c_{44}\} \quad (4)$$

Then a mapping $(\omega_1, \omega_2), a_1 \times a_2 \times \ldots \times a_n \rightarrow P(U)$ Is called DFHS[25], [26]

$$\omega_1(c_{11}, c_{21}, c_{31}, c_{41}) = \{A_1, A_3\} \quad (5)$$

$$\omega_2(c_{11}, c_{21}, c_{31}, c_{41}) = \{A_2, A_4\} \quad (6)$$

$$\omega_1(c_{11}, c_{21}, c_{31}, c_{41}) = \{A_1\} \quad (7)$$

$$\omega_2(c_{11}, c_{21}, c_{31}, c_{41}) = \{A_2\} \quad (8)$$

We show the steps of the MOORA method under the DFHS to rank the alternatives based on the criteria weights.

Experts created the decision matrix between the criteria using a scale between 0 and 1. The decision matrix is combined into a single matrix. We compute the criteria weights using the average method.

Compute the ratio system such as:

$$Q_{ij} = x_{ij} / \sqrt{\sum_{i=1}^{m} x_{ij}^2} \, ; i = 1,2, \ldots, m; j = 1,2, \ldots, n; \quad (9)$$

Compute the normalized values for positive and cost criteria such as

$$H_i = \sum_{j=1}^{g} Q_{ij} - \sum_{j=i+1}^{n} Q_{ij} \quad (10)$$

Compute the weighted decision matrix

$$R_i = \sum_{j=1}^{g} w_j H_{ij} - \sum_{j=g+1}^{n} w_j H_{ij} \quad (11)$$

3. Results

This section shows the results of the DFHS to show the best alternatives based on a set of criteria. This study uses eight criteria and eight alternatives such as:

The criteria with values such as:

- Curriculum Relevance {High, Medium, Low}
- Faculty Expertise {Expert, Competent, Novice}
- Industry Collaboration {Strong, Moderate, Weak}
- Student Engagement {Active, Passive, Inactive}
- Resource Availability {Abundant, Adequate, Scarce}
- Teaching Methodology {Innovative, Traditional, Mixed}
- Institutional Support {Strong, Neutral, Weak}
- Evaluation Techniques {Realistic, Theoretical, Mixed}

The alternatives are: Traditional Lecture-Based Approach, Case-Based Teaching with Real Entrepreneurial Scenarios, Project-Based Learning with Start-Up Development, Industry Mentorship and Internship-Integrated Learning, Hackathons, Innovation Challenges, and Startup Competitions, Interdisciplinary Collaboration-Based Teaching, Online and Blended Entrepreneurship Programs, Problem-Based Learning Using Digital Prototyping Tools.

Three experts created the decision matrices. We combine these decision matrices into a single matrix. We compute the criteria weights using the average method.

C1= 0.1228, This criterion has moderate weight, indicating that aligning the curriculum with current innovation and entrepreneurship trends is important but not the most critical factor.

C2= 0.1238, Slightly more important than C1, this shows that the qualifications and experience of faculty members are key in delivering effective instruction.

C3= 0.1212, Also moderately weighted, this suggests that partnerships with industry are beneficial but may be secondary to internal academic factors.

C4= 0.1446, This is the highest-weighted criterion, indicating that active student participation and interaction are considered crucial for improving instruction.

C5= 0.1157, This has the lowest weight, suggesting that while having sufficient resources (labs, funding, materials) is helpful, it's not as pivotal as other pedagogical or structural elements.

C6= 0.1249, This weight reflects that innovative teaching approaches (like project-based or experiential learning) are a strong factor in instructional effectiveness.

C7= 0.1201, A moderate weight that shows vocational college-level backing (funding, policy, infrastructure) is a meaningful contributor to instructional success.

C8= 0.1270, This relatively high weight emphasizes the importance of effective and realistic assessment methods in measuring and enhancing instructional quality.

We use the definitions of the DFHS to evaluate the alternatives, we divided the alternatives into double frames such as:

First frame, ({High}, {Expert}, {Strong}, {Active}, {Abundant}, {Innovative}, {Strong}, {Mixed})={A_1, A_3, A_5, A_7}

Second frame, ({High}, {Expert}, {Strong}, {Active}, {Abundant}, {Innovative}, {Strong}, {Mixed})={A_2, A_4, A_6, A_8}

In the first frame: we show the results of the MOORA method such as:

Compute the ratio system using eq. (9) as shown in Fig 1.

Compute the normalized values for positive and cost criteria using eq. (10).

Compute the weighted decision matrix using eq. (11) as shown in Fig 2. We obtained the final score as shown in Fig 3. We rank the alternatives as shown in Fig 4.

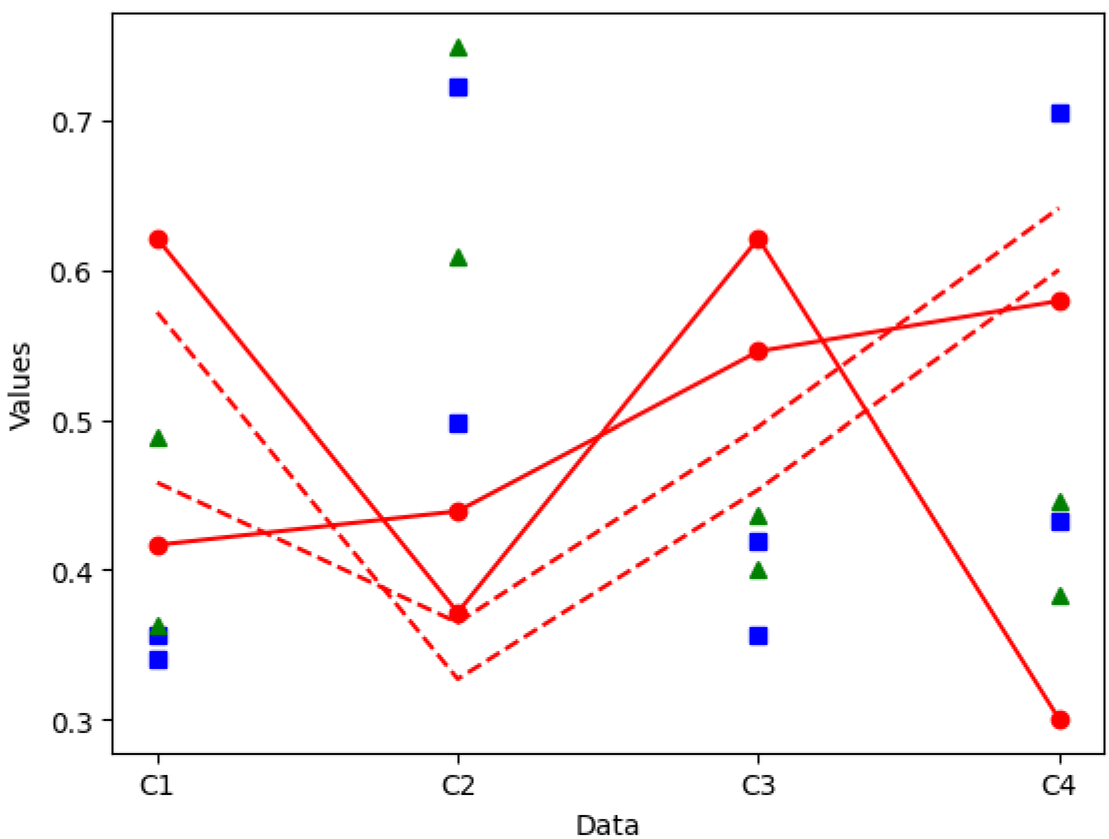

Fig 1. The ratio system values.

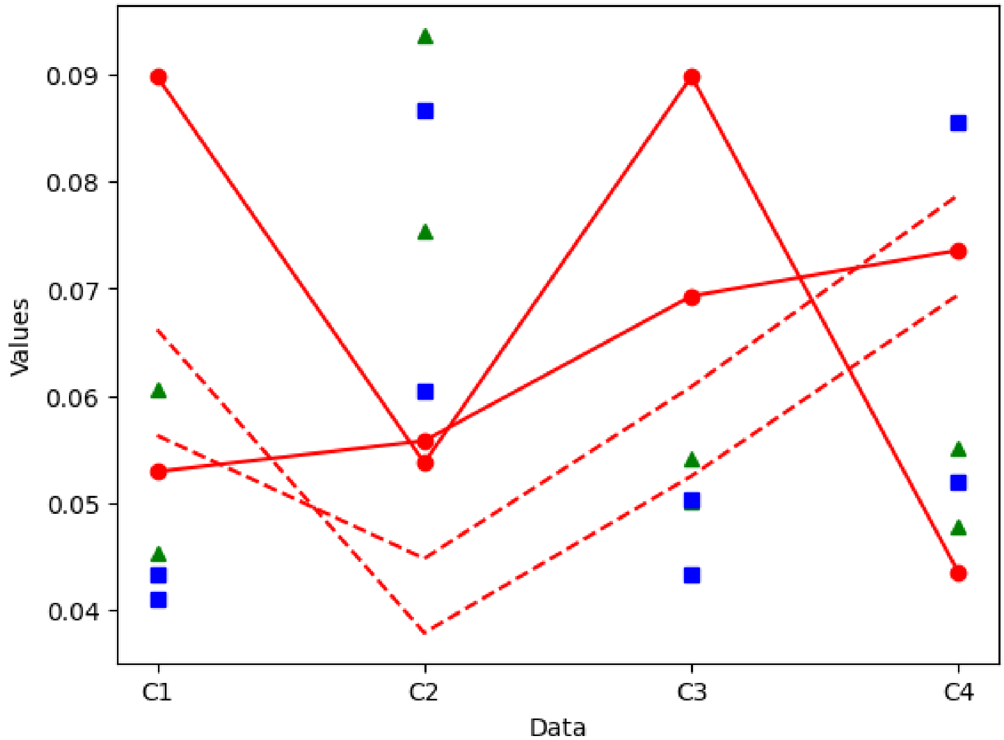

Fig 2. The weighted matrix.

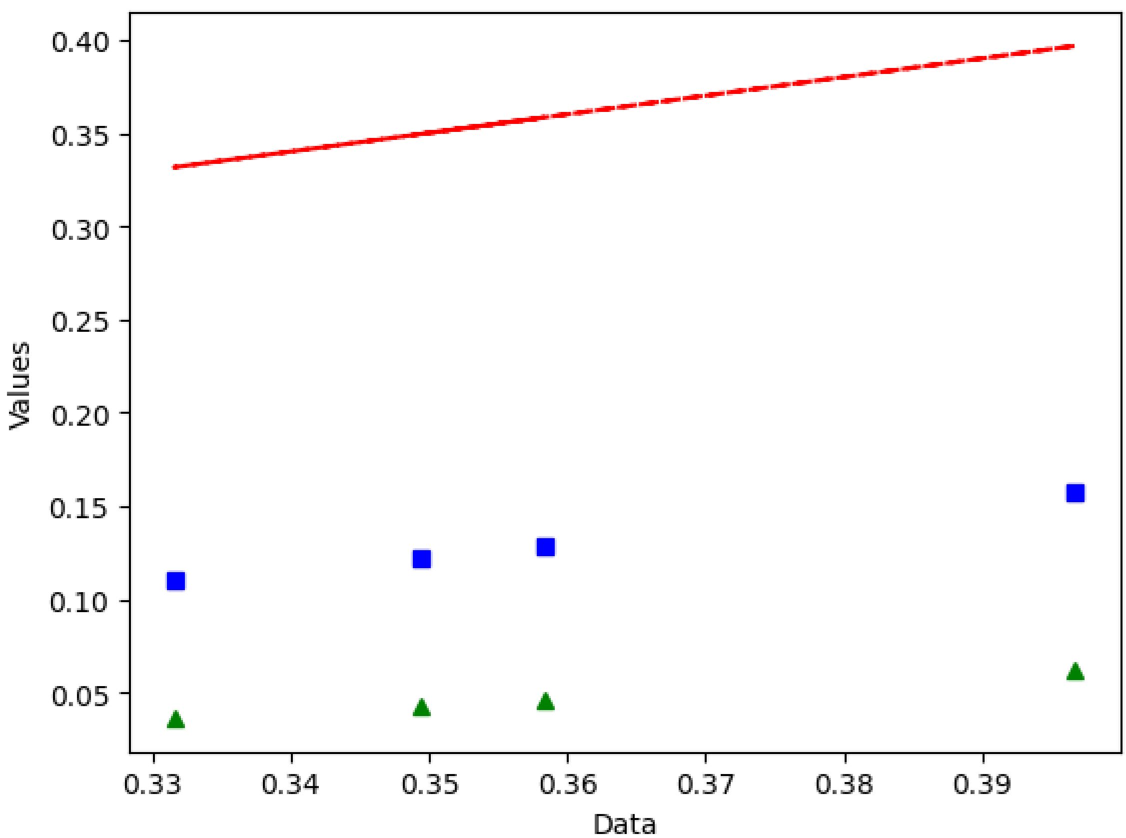

Fig 3. The final score.

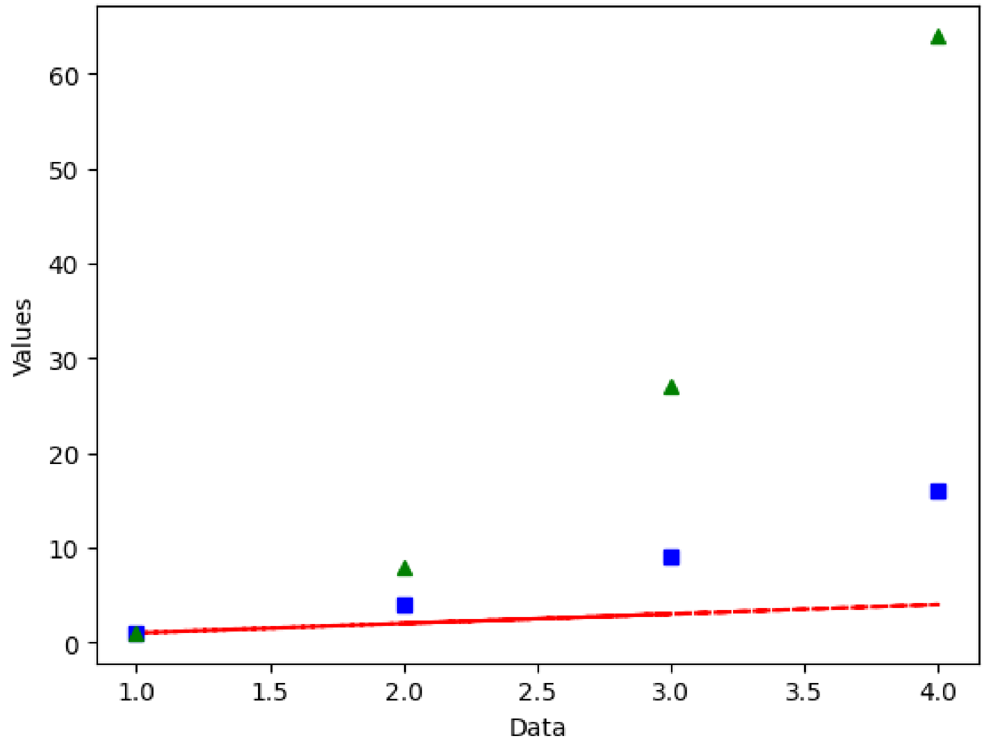

Fig 4. The ranks of alternatives.

In the second frame: we show the results of the MOORA method such as:

Compute the ratio system using eq. (9) as shown in Fig 5.

Compute the normalized values for positive and cost criteria using eq. (10).

Compute the weighted decision matrix using eq. (11) as shown in Fig 6. We obtained the final score as shown in Fig 7. We rank the alternatives as shown in Fig 8.

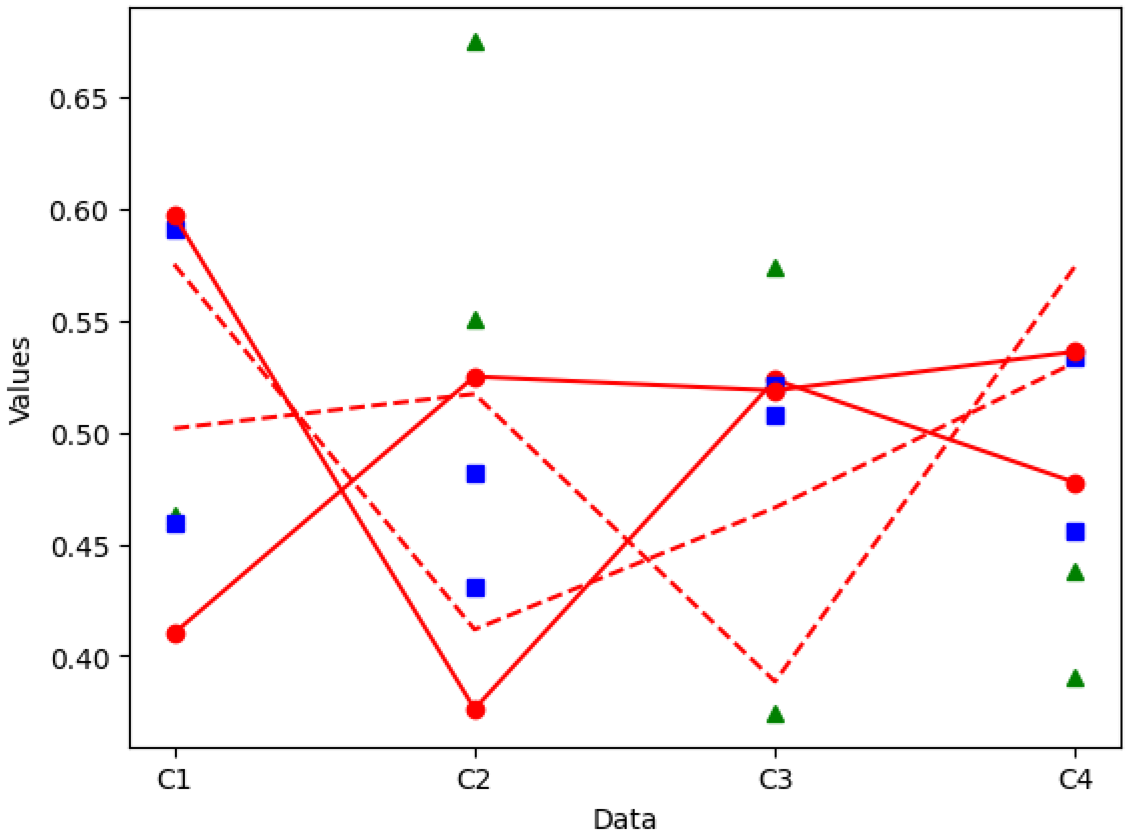

Fig 5. The ratio system values.

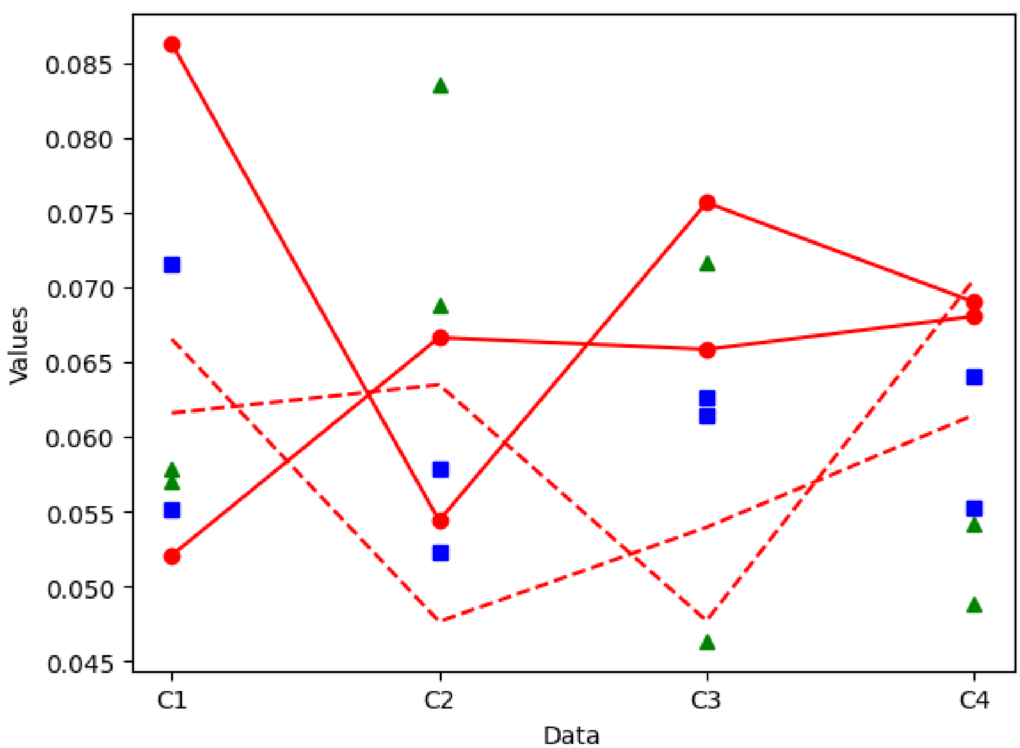

Fig 6. The weighted matrix.

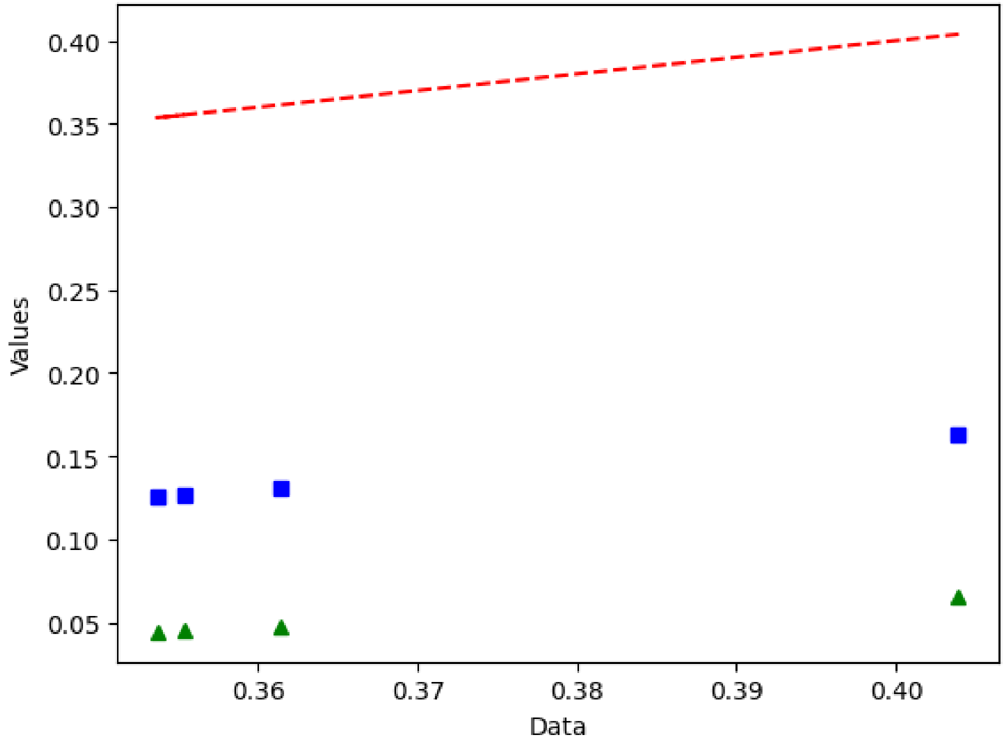

Fig 7. The final score.

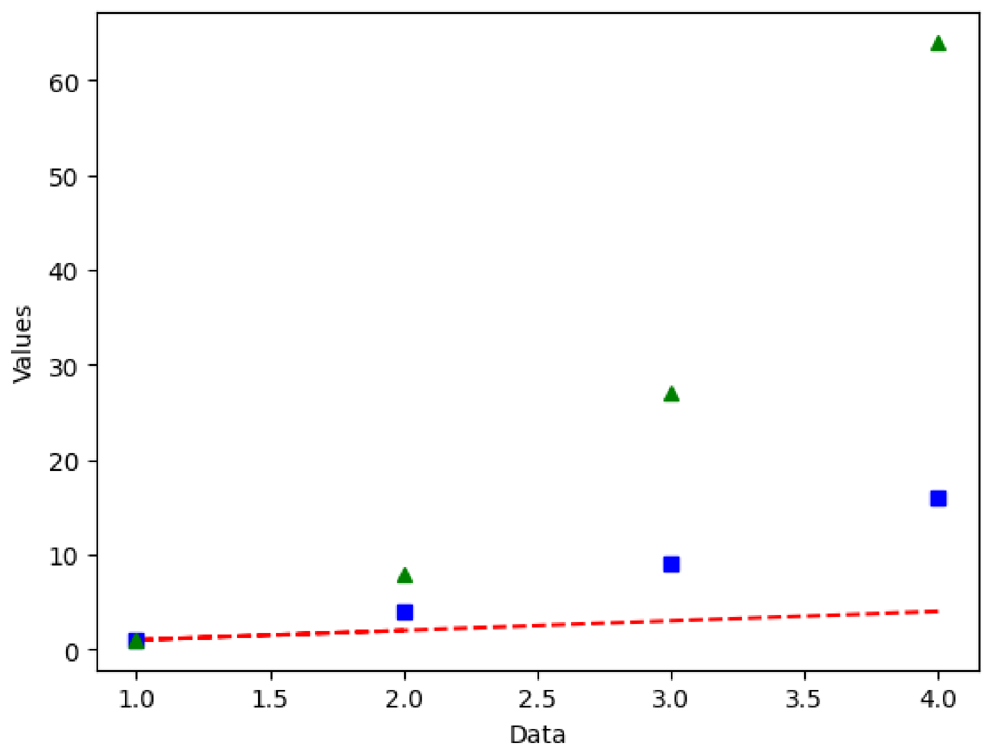

Fig 8. The ranks of alternatives.

We show the analysis of the results of the two frames. In the first frame:

A1, 2, A1 performs below top level, showing good potential but has room for improvement. It is considered a moderately strong choice.

A3, 4, A3 holds the highest rank, indicating it is the most effective or competitive alternative among the four. It demonstrates excellent performance.

A5, 1, A5 is the lowest ranked, suggesting weakness or underperformance in the evaluated criteria. It may require significant improvement.

A7, 3, A7 ranks just below the top, showing strong performance, though not quite at the level of A3. It is a reliable and capable option.

The ranks of the second frame:

A2, 4, A2 is ranked highest, indicating it performs exceptionally well compared to others. It is the top choice with outstanding qualities or results.

A4, 3, A4 is in the third position, reflecting solid performance, but it falls just short of being the best. It's strong, but not quite exceptional.

A6, 1, A6 is the lowest ranked, showing poor performance or underachievement. It needs significant improvement to reach higher ranks.

A8, 2, A8 ranks second, indicating it performs above average but does not quite reach the level of A2. It's a strong alternative, though not the best.

4. Conclusions

The evaluation revealed that innovation and entrepreneurship instruction must move beyond traditional teaching paradigms to stay relevant in today's dynamic landscape. Strategies like project-based learning, industry mentorship, and hackathon-based learning scored the highest in effectiveness, particularly due to their strong alignment with experiential and applied learning models. These methods directly connect students with real-world challenges and entrepreneurial ecosystems. In contrast, conventional methods such as lecture-based instruction were less effective due to limited engagement and practical relevance.

Furthermore, student engagement, curriculum relevance, and industry exposure emerged as top-weighted criteria, indicating that effective instruction must center around immersion, relevance, and real-world application. Vocational colleges are encouraged to invest in platforms that support cross-disciplinary collaboration, provide access to innovation labs, and integrate technological tools to modernize instructional delivery. We used the Double Framed HyperSoft Set to deal with the criteria values. The MOORA method is used to rank the alternatives.

By prioritizing active and experiential methods, institutions can significantly improve student outcomes in innovation and entrepreneurship. This study contributed to a practical decision-making model for administrators and educators seeking to elevate their programs and produce the next generation of changemakers.

References

[1] R. Zhou, S. M. Rashid, and S. Cheng, “Entrepreneurship education in Chinese higher institutions: Challenges and strategies for vocational colleges,” *Cogent Educ.*, vol. 11, no. 1, p. 2375080, 2024.

[2] J. ZHENG, S. ZHAO, Y. LU, J. YE, and J. DING, “Exploration and practice of whole process talent cultivation in Traditional Chinese Medicine based on innovation and entrepreneurship education,” *Res. High. Educ. Pharm.*, vol. 42, no. 1, p. 21, 2024.

[3] J. Liu, “Exploration and Practice of Curriculum System Construction of Innovation and Entrepreneurship Education in Higher Vocational Schools from the Perspective of Educational-business Alliances,” in *Proceedings of the International Conference on Social Science, Education and Management (ICSSEM 2024), Dalian, China*, 2024, pp. 28–29.

[4] R. Peng and C. Qi, “Innovation and entrepreneurship education in China: Responding to social change.,” *Growth Chang.*, vol. 55, no. 1, 2024.

[5] S. Pan, B. Hafez, A. Iskandar, and Z. Ming, “Integrating constructivist principles in an adaptive hybrid learning system for developing social entrepreneurship education among college students,” *Learn. Motiv.*, vol. 87, p. 102023, 2024.

[6] F. Iddris, “Entrepreneurship education on international entrepreneurship intention: the role of entrepreneurship alertness, proactive personality, innovative behaviour and global mindset,” *J. Appl. Res. High. Educ.*, vol. 17, no. 2, pp. 640–662, 2025.

[7] Q. Mu and Y. Zhao, “Transforming entrepreneurship education in the age of artificial intelligence,” *Resour. Data J.*, vol. 3, pp. 2–20, 2024.

[8] C. Zhao, H. Hou, and H. Yan, “Intuitionistic Linguistic EDAS Method with New Score Function: Case Study on Evaluating Universities’ Innovation and Entrepreneurship Education,” *Systems*, vol. 12, no. 9, p. 368, 2024.

[9] K. Anubhav, A. K. Dwivedi, and K. Aashish, “Entrepreneurship education in higher education (2002–2022): A technology-empowered systematic literature review,” *Int. J. Manag. Educ.*, vol. 22, no. 3, p. 100993, 2024.

[10] A. T. Rosário and R. Raimundo, “Sustainable entrepreneurship education: a systematic bibliometric literature review,” *Sustainability*, vol. 16, no. 2, p. 784, 2024.

[11] H. Feng, A. A. Musah, O. B. Keat, and Y. Wei, “Bridging the Gap: How Innovation and Entrepreneurship Education Prepares Medical Students for the Workforce,” *Revolution*, vol. 4, p. 5, 2024.

[12] I. Sitaridis and F. Kitsios, "Digital entrepreneurship and entrepreneurship education: a review of the literature," *Int. J. Entrep. Behav. Res.*, vol. 30, no. 2/3, pp. 277–304, 2024.

[13] X. Feng, X. Wang, and M. Qi, "A comparison study on innovation and entrepreneurship education in and out of China from a bibliometric perspective," *Libr. Hi Tech*, vol. 42, no. 6, pp. 1810–1838, 2024.

[14] X. Wang, "Research on the influencing factors and upgrading paths for innovation and entrepreneurship education in universities under the background of sustainable development goals: a QCA empirical study on new engineering of Chinese and foreign universities," *Int. J. Sustain. High. Educ.*, vol. 25, no. 7, pp. 1426–1452, 2024.

[15] I. Alshakhatreh, D. Thiombiano, and S. Al-Majali, "Literature Review on Multi-Criteria Analysis and Application in Education Environment," *J. Oper. Intell.*, vol. 2, no. 1, pp. 236–267, 2024.

[16] D. Gottwald, J. Chocholáč, M. Kayacı Çodur, M. Čubranić-Dobrodolac, and K. Yazir, "Z-Numbers-Based MCDM approach for personnel selection at institutions of higher education for transportation," *Mathematics*, vol. 12, no. 4, p. 523, 2024.

[17] P.-H. Nguyen, "A data-driven MCDM approach-based spherical fuzzy sets for evaluating global augmented reality providers in education," *IEEE Access*, vol. 13, pp. 6102–6119, 2024.

[18] S. Srivastava, A. Tripathi, and N. Arora, "Multi-criteria decision making (MCDM) in diverse domains of education: a comprehensive bibliometric analysis for research directions," *Int. J. Syst. Assur. Eng. Manag.*, pp. 1–18, 2024.

[19] M. A. Al-Gerafi *et al.*, "Designing of an effective e-learning website using inter-valued fuzzy hybrid MCDM concept: A pedagogical approach," *Alexandria Eng. J.*, vol. 97, pp. 61–87, 2024.

[20] M. B. Bouraima, I. Badi, O. O. Makinde, E. A. Kassembe, and F. Muya, "Prioritizing Strategies for the Development and Sustainability of Higher Education in Developing Countries: A FullEX MCDM Approach," *Spectr. Decis. Mak. Appl.*, vol. 2, no. 1, pp. 166–176, 2025.

[21] F. Smarandache, *New types of soft sets "hypersoft set, indetermsoft set, indetermhypersoft set, and treesoft set": an improved version*. Infinite Study, 2023.

[22] F. Smarandache, *Introduction to the IndetermSoft Set and IndetermHyperSoft Set*, vol. 1. Infinite Study, 2022.

[23] F. Smarandache, "Foundation of the SuperHyperSoft Set and the Fuzzy Extension SuperHyperSoft Set: A New Vision," *Neutrosophic Syst. with Appl.*, vol. 11, pp. 48–51, 2023.

[24] M. Saeed, H. I. ul Haq, and M. Ali, "Extension of double frame soft set to double frame hypersoft set (dfss to dfhss)," *HyperSoft Set Methods Eng.*, vol. 2, pp. 18–27, 2024.

[25] A. K. Das, F. Smarandache, R. Das, and S. Das, *A Comprehensive Study on Decision-Making Algorithms in Retail and Project Management using Double Framed Hypersoft Sets*. Infinite Study, 2024.

[26] T. Fujita and F. Smarandache, "An introduction to advanced soft set variants: Superhypersoft sets, indetermsuperhypersoft sets, indetermtreesoft sets, bihypersoft sets, graphicsoft sets, and beyond," *Neutrosophic Sets Syst.*, vol. 82, pp. 817–843, 2025.

Received: Nov. 22, 2024. Accepted: April 20, 2025