NSS
Neutrosophic Sets and Systems, Vol. 88, 2025
University of New Mexico

Double-Valued Neutrosophic Offset for Enhancing Humanistic Competence: An Effectiveness Study of Humanities Instruction in Vocational College Students

Lingling Lin*

Beijing College of Finance and Commerce, Peking,100000, China

*Corresponding author, E-mail: 18612523862@163.com

Abstract: In the context of increasingly skills-oriented education, vocational colleges face the challenge of producing technically competent graduates who are also ethically grounded, culturally aware, and socially responsible. This study examines the effectiveness of humanities instruction in fostering humanistic competence among vocational college students. Six key evaluation criteria—critical thinking, ethical awareness, communication skills, cultural understanding, interpersonal abilities, and real-world applicability—are used to assess six distinct instructional approaches through a neutrosophic set framework. Data was gathered from student surveys, faculty interviews, and classroom observations across multiple institutions. This study uses the neutrosophic set framework to overcome uncertainty information. We use the Double-Valued Neutrosophic Offset to evaluate the criteria and alternatives. The results demonstrate that interdisciplinary project-based learning (PBL) and courses emphasizing ethics and civic responsibility most effectively promote holistic student development. The findings underline the value of humanities in shaping not only employable but also reflective and socially engaged graduates, offering evidence-based recommendations for curriculum planners in vocational education settings.

Keywords: Double-Valued Neutrosophic Offset; Humanistic Competence; Humanities Instruction; Humanities Instruction.

1. Introduction

Most issues in the modern world entail uncertainty, which must be appropriately managed before analysis can begin. Uncertainty is not adequately described by traditional mathematical theories. Too far, scholars have created a variety of models to address it. For instance, Zadeh [1] considered a membership degree (MED) while introducing the concept of fuzzy sets (FS). Since FS only uses MED, it views the other words as a supplement to the MED. It may not, however, always hold true in different problems.

As a result, an expert has been reserved to deal with the data's ambiguity. Additionally, there may be instances in which an expert offers a rating in an impartial way for a variety of problems. By dealing with the three independent degrees—MED, NMED, and indeterminacy degree (IED) over the standard or non-standard real subsets, Smarandache [2], [3] developed a neutrosophic set (NS) to address this.

1.1 Literature Review

Diversification and abstraction define the substance of humanistic literacy. When individuals set aside their earthly lives to pursue a higher spiritual realm, it is the essence that has been retained throughout the evolution of human society. The prospects for higher vocational education are bright since the Chinese government has recently offered political backing for the field's rapid and healthy growth. However, a lot of higher vocational colleges have overlooked the value of humanistic literacy in developing talents, which has led to a lack of comprehensive quality in students. This has limited the students' ability to develop their personalities in a healthy way, which ultimately results in low social adaptability and hinders the students' comprehensive development. Using higher vocational colleges as an example, Wang [4] examined the issues and solutions surrounding the teaching of humanistic literacy at these institutions with the goal of offering future resources for higher vocational education reform.

Because technical education is still primarily pragmatic in reaction to industrial demands, certification standards, and educational standardization, humanism has never been able to take root there. However, as part of the shift to student-centered education, humanism has partially recovered after a period of decline. A technical college's research revealed that even so. According to a study of Chen et al. [5], incorporating humanistic components into teaching methods will help teachers better assist students in acquiring skills related to problem-solving, teamwork, systems improvement, lifelong learning, and other areas that are becoming more and more important for success in the workplace.

Employers are constantly improving the quality criteria of higher vocational college graduates because of the economic industrial structure's upgrading and adjustment. Higher vocational college students should possess sophisticated technological skills together with a strong moral and cultural foundation[6]. The current state of higher vocational institutions' humanistic quality education is not encouraging, and the adage "heavy skill, light humanity" is pervasive. Some strategies are employed to enhance the professionalism of graduates and human education, including establishing reasonable learning objectives for higher vocational education, developing innovative teaching strategies, fortifying the development of teaching staff, and so forth. These solutions significantly enhance the humanistic quality of instruction at higher vocational institutes.

2. Double-Valued Neutrosophic Offset

This section shows the definitions of Double-Valued Neutrosophic Offset (DVNOs) with different examples[7].

Definition 2.1

Let U_{off} be a universe of discourse with under limit $Y < 0$ and overlimit $Z > 1$. We can define the DVNOs such as:

$$A_{off} = \left\{\left(h, \left(T(h), I_T(h), I_F(h), F(h)\right)\right) | h \in U_{off}\right\}$$

$$T(h), I_T(h), I_F(h), F(h): U_{off} \to [Y, Z]$$

- $T(h)$ refers to the truth membership function.
- $I_T(h)$ refers to the indeterminacy toward truth membership function.
- $I_F(h)$ refers to the indeterminacy toward falsity membership function.
- $F(h)$ refers to the falsity membership function.

Example 2.2

Let $Y = -0.1\ and\ Z = 1.1$ and DVNOs is:

$$A_{off} = \begin{Bmatrix} \left(B_1, (1.3,0.1,0.05,0.05)\right), \\ \left(B_2, (0.4,0.1,0.3,1.2)\right) \end{Bmatrix}$$

For B1

$$T(B_1) = 1.3 > 1, I_T(B_1) = 0.1, I_F(B_1) = 0.05, F(B_1) = 0.05$$

This refers to the truth function values greater than 1.

For B2

$$T(B_2) = 0.4, I_T(B_2) = 0.1, I_F(B_2) = 0.3, F(B_2) = 1.2 > 1$$

This refers to the falsity function values greater than 1.

A realistic Offset scenario in reliability evaluation is demonstrated by the fact that at least one membership degree in both situations falls outside the traditional [0, 1] interval.

Example 2.3

Let $Y = -0.3\ and\ Z = 1.7$ and DVNOs is:

$$A_{off} = \begin{Bmatrix} \left(B_1, (1.6,0.2,0.1,0.1)\right), \\ \left(B_2, (0.3,0.1,0.2,1.5)\right) \end{Bmatrix}$$

For B1

$$T(B_1) = 1.6 > 1, I_T(B_1) = 0.2, I_F(B_1) = 0.1, F(B_1) = 1$$

This refers to the truth function values greater than 1.

For B2

$$T(B_2) = 0.3, I_T(B_2) = 0.1, I_F(B_2) = 0.2, F(B_2) = 1.5 > 1$$

This refers to the falsity function values greater than 1.

A realistic Offset scenario in reliability evaluation is demonstrated by the fact that at least one membership degree in both situations falls outside the traditional [0, 1] interval.

Definition 2.4

We can obtain the complement of DVNOs by:

$$A_{off}^{c} = \left\{\left(h, \left(T^{c}(h), I_T^{c}(h), I_F^{c}(h), F^{c}(h)\right)\right) | h \in U_{off}\right\}$$

$$T^{c}(h) = F(h)$$

$$I_T^{c}(h) = I_F(h)$$

$$I_F^{c}(h) = I_T(h)$$

$$F^{c}(h) = T(h)$$

Definition 2.5

We can define the union of the DVNOs.

$$T_{A\cup B}(h) = \max\{T_A(h), T_B(h)\}$$

$$I_{T_{A\cup B}}(h) = \min\left\{I_{T_A}(h), I_{T_B}(h)\right\}$$

$$I_{F_{A\cup B}}(h) = \min\left\{I_{F_A}(h), I_{F_B}(h)\right\}$$

$$F_{A\cup B}(h) = \min\{F_A(h), F_B(h)\}$$

Definition 2.6

We can obtain the intersection of the DVNOs such as:

$$T_{A\cap B}(h) = \min\{T_A(h), T_B(h)\}$$

$$I_{T_{A\cap B}}(h) = \max\left\{I_{T_A}(h), I_{T_B}(h)\right\}$$

$$I_{F_{A\cap B}}(h) = \max\left\{I_{F_A}(h), I_{F_B}(h)\right\}$$

$$F_{A\cap B}(h) = \max\{F_A(h), F_B(h)\}$$

3. Double-Valued Neutrosophic Offset Methodology

This section shows the methodology of DVNOs in this study.

Step 1. Consider the set of criteria evaluated by the DVNOs.

Step 2. Consider the set of alternatives evaluated by the DVNOs.

Step 3. Combine the DVNOs using the union of DVNOs.

Step 4. Apply the Euclidean distance to obtain crisp values.

$$D(A,B) = \sqrt{\begin{matrix}\left(T_A(h) - T_B(h)\right)^2 + \left(I_{T_A}(h) - I_{T_B}(h)\right)^2 + \\ \left(I_{F_A}(h) - I_{F_A}(h)\right)^2 + \left(F_A(h) - F_A(h)\right)^2\end{matrix}}$$

Step 5. Rank the alternatives based on highest value of $D(A,B)$.

4. Application

This section shows the application of the proposed approach to show the best alternatives based on different criteria. This study uses six criteria and six alternatives as shown in Figure 1. Four experts evaluate the criteria and alternatives using the DVNOs as shown in Table 1. Then we use the DVNOs to combine the different opinions into one matrix as shown in Figures 2-7.

Figure 1. Standards of Enhancing Humanistic Competence: An Effectiveness Study of Humanities Instruction in Vocational Colleges.

Table 1. DVNOs.

	DVC_1	DVC_2	DVC_3	DVC_4	DVC_5	DVC_6
DVA_1	⟨1.2, 0.05, 0, 0)	(0.3, 0.1, 0.2, 1.1)	(1.3,0.1,0.05,0.05)	(0.4,0.1,0.3,1.2)	(1.6,0.2,0.1,0.1)	(0.3,0.1,0.2,1.5)
DVA_2	⟨1.2, 0.05, 0, 0)	(0.5,0.4,0.3,1.4)	(0.3,0.1,0.2,1.5)	(1.6,0.2,0.1,0.1)	(0.4,0.1,0.3,1.2)	(1.3,0.1,0.05,0.05)
DVA_3	(0.3, 0.1, 0.2, 1.1)	(1.3,0.1,0.05,0.05)	(0.4,0.1,0.3,1.2)	(1.6,0.2,0.1,0.1)	(0.3,0.1,0.2,1.5)	(0.3, 0.1, 0.2, 1.1)
DVA_4	(0.4,0.1,0.3,1.2)	(1.3,0.1,0.05,0.05)	(0.3, 0.1, 0.2, 1.1)	⟨1.2, 0.05, 0, 0)	(0.5,0.4,0.3,1.4)	⟨1.2, 0.05, 0, 0)
DVA_5	(1.6,0.2,0.1,0.1)	(0.4,0.1,0.3,1.2)	(1.3,0.1,0.05,0.05)	(0.3, 0.1, 0.2, 1.1)	⟨1.2, 0.05, 0, 0)	(0.5,0.4,0.3,1.4)
DVA_6	(1.6,0.2,0.1,0.1)	(1.6,0.2,0.1,0.1)	(0.4,0.1,0.3,1.2)	(1.6,0.2,0.1,0.1)	(0.5,0.4,0.3,1.4)	(0.3,0.1,0.2,1.5)
	DVC_1	DVC_2	DVC_3	DVC_4	DVC_5	DVC_6
DVA_1	(0.4,0.1,0.3,1.2)	(0.3, 0.1, 0.2, 1.1)	(1.3,0.1,0.05,0.05)	(0.4,0.1,0.3,1.2)	(1.6,0.2,0.1,0.1)	(0.3,0.1,0.2,1.5)
DVA_2	(1.3,0.1,0.05,0.05)	(0.5,0.4,0.3,1.4)	(0.3,0.1,0.2,1.5)	(0.4,0.1,0.3,1.2)	(0.4,0.1,0.3,1.2)	(1.3,0.1,0.05,0.05)
DVA_3	(0.3, 0.1, 0.2, 1.1)	(1.3,0.1,0.05,0.05)	(0.4,0.1,0.3,1.2)	(1.3,0.1,0.05,0.05)	(0.4,0.1,0.3,1.2)	(0.3, 0.1, 0.2, 1.1)
DVA_4	⟨1.2, 0.05, 0, 0)	(1.3,0.1,0.05,0.05)	(0.3, 0.1, 0.2, 1.1)	(0.3, 0.1, 0.2, 1.1)	(1.3,0.1,0.05,0.05)	⟨1.2, 0.05, 0, 0)
DVA_5	(0.5,0.4,0.3,1.4)	(0.4,0.1,0.3,1.2)	(1.3,0.1,0.05,0.05)	⟨1.2, 0.05, 0, 0)	(0.3, 0.1, 0.2, 1.1)	(0.5,0.4,0.3,1.4)
DVA_6	(0.4,0.1,0.3,1.2)	(0.4,0.1,0.3,1.2)	(0.4,0.1,0.3,1.2)	(0.5,0.4,0.3,1.4)	⟨1.2, 0.05, 0, 0)	(0.4,0.1,0.3,1.2)
	DVC_1	DVC_2	DVC_3	DVC_4	DVC_5	DVC_6
DVA_1	⟨1.2, 0.05, 0, 0)	(0.3, 0.1, 0.2, 1.1)	(1.3,0.1,0.05,0.05)	(0.4,0.1,0.3,1.2)	(1.6,0.2,0.1,0.1)	(0.3,0.1,0.2,1.5)
DVA_2	(0.5,0.4,0.3,1.4)	(0.5,0.4,0.3,1.4)	(0.3,0.1,0.2,1.5)	(1.6,0.2,0.1,0.1)	(0.4,0.1,0.3,1.2)	(1.3,0.1,0.05,0.05)
DVA_3	(0.3,0.1,0.2,1.5)	⟨1.2, 0.05, 0, 0)	(0.4,0.1,0.3,1.2)	(1.6,0.2,0.1,0.1)	(0.3,0.1,0.2,1.5)	(0.3, 0.1, 0.2, 1.1)
DVA_4	(1.6,0.2,0.1,0.1)	(0.5,0.4,0.3,1.4)	⟨1.2, 0.05, 0, 0)	⟨1.2, 0.05, 0, 0)	⟨1.2, 0.05, 0, 0)	⟨1.2, 0.05, 0, 0)
DVA_5	(0.4,0.1,0.3,1.2)	(0.3,0.1,0.2,1.5)	(0.5,0.4,0.3,1.4)	⟨1.2, 0.05, 0, 0)	(0.5,0.4,0.3,1.4)	⟨1.2, 0.05, 0, 0)
DVA_6	(1.3,0.1,0.05,0.05)	(1.6,0.2,0.1,0.1)	(0.3,0.1,0.2,1.5)	(0.5,0.4,0.3,1.4)	(0.3,0.1,0.2,1.5)	(0.5,0.4,0.3,1.4)
	DVC_1	DVC_2	DVC_3	DVC_4	DVC_5	DVC_6
DVA_1	(0.3,0.1,0.2,1.5)	(0.5,0.4,0.3,1.4)	(0.3, 0.1, 0.2, 1.1)	(0.5,0.4,0.3,1.4)	(1.6,0.2,0.1,0.1)	(0.4,0.1,0.3,1.2)
DVA_2	(0.5,0.4,0.3,1.4)	⟨1.2, 0.05, 0, 0)	⟨1.2, 0.05, 0, 0)	⟨1.2, 0.05, 0, 0)	(0.4,0.1,0.3,1.2)	(1.3,0.1,0.05,0.05)
DVA_3	(0.5,0.4,0.3,1.4)	(0.3, 0.1, 0.2, 1.1)	(0.5,0.4,0.3,1.4)	(0.3, 0.1, 0.2, 1.1)	(1.3,0.1,0.05,0.05)	(0.3, 0.1, 0.2, 1.1)
DVA_4	(0.3, 0.1, 0.2, 1.1)	(0.3, 0.1, 0.2, 1.1)	(0.3, 0.1, 0.2, 1.1)	(1.6,0.2,0.1,0.1)	(1.3,0.1,0.05,0.05)	(0.3, 0.1, 0.2, 1.1)
DVA_5	⟨1.2, 0.05, 0, 0)	⟨1.2, 0.05, 0, 0)	⟨1.2, 0.05, 0, 0)	⟨1.2, 0.05, 0, 0)	(0.3, 0.1, 0.2, 1.1)	⟨1.2, 0.05, 0, 0)
DVA_6	(0.5,0.4,0.3,1.4)	(0.5,0.4,0.3,1.4)	(0.5,0.4,0.3,1.4)	(0.3, 0.1, 0.2, 1.1)	⟨1.2, 0.05, 0, 0)	(0.5,0.4,0.3,1.4)

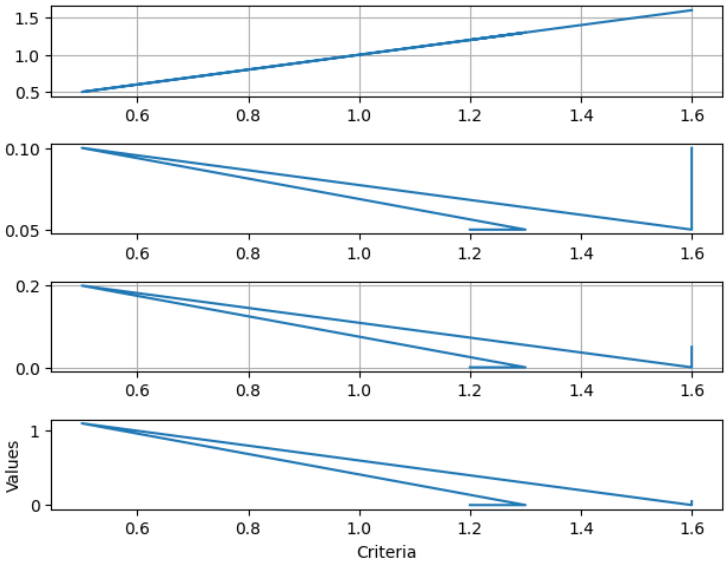

Figure 2. First Criterion Values.

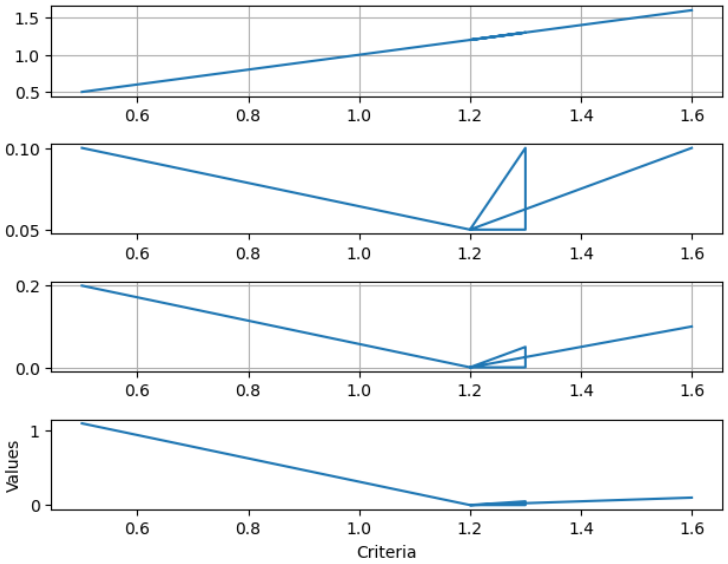

Figure 3. Second Criterion Values.

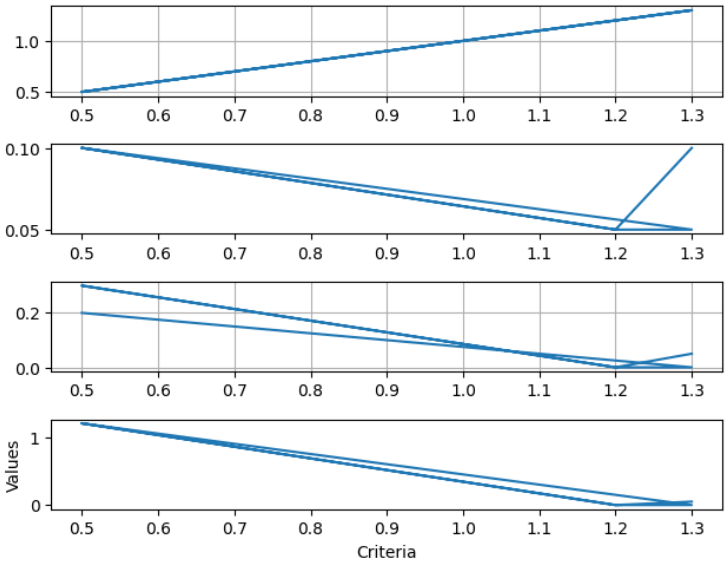

Figure 4. Third Criterion Values.

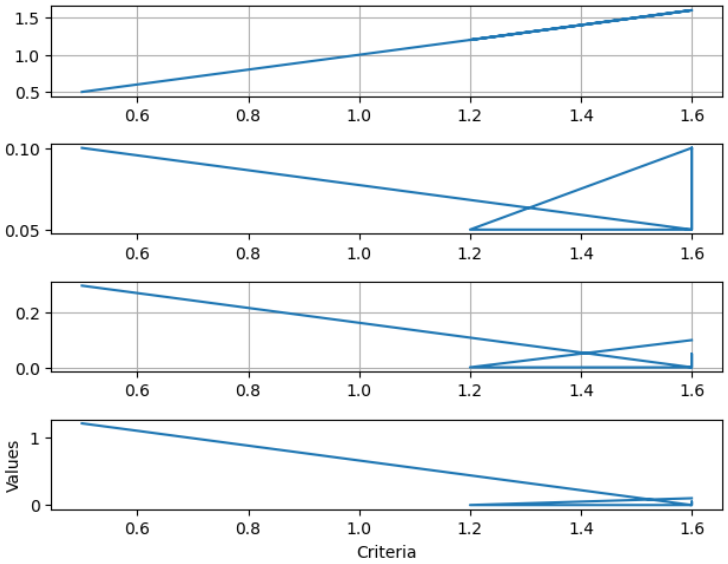

Figure 5. Fourth Criterion Values.

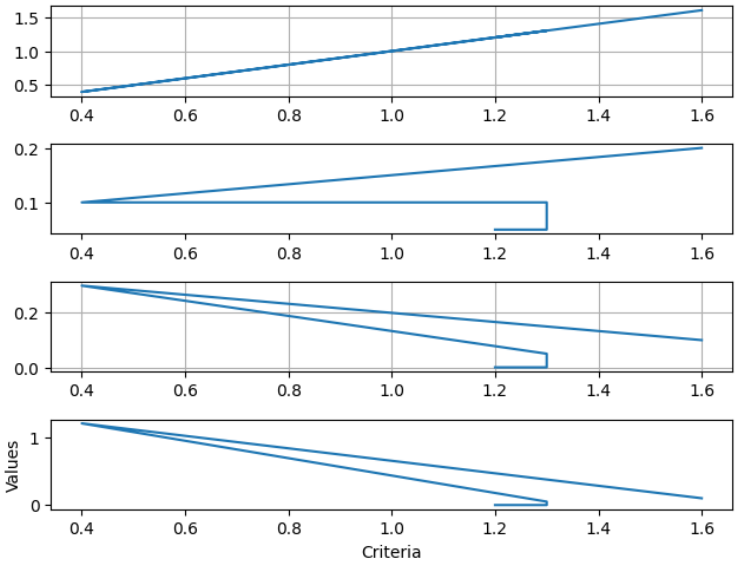

Figure 6. Fifth Criterion Values.

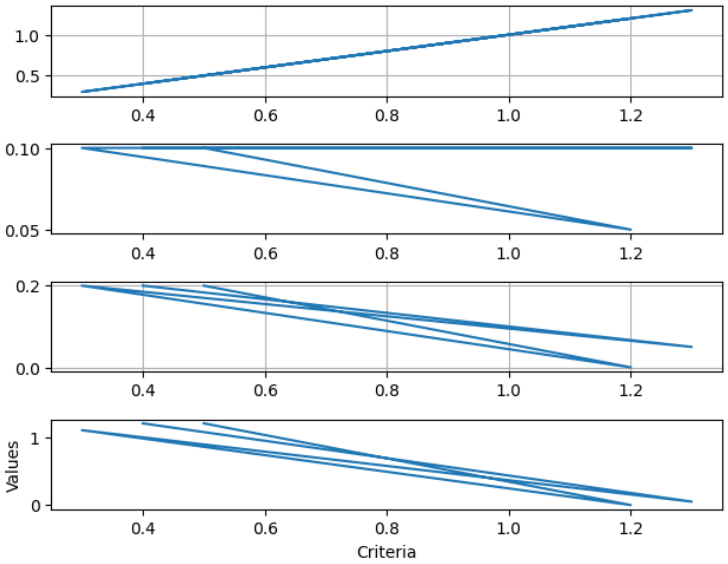

Figure 7. Sixth Criterion Values.

The Euclidean distance is applied to obtain the final score of each alternative as shown in Figure 8. Finnly, the alternatives are ranked. The results show alternative 4 is the best and alternative 5 is the worst.

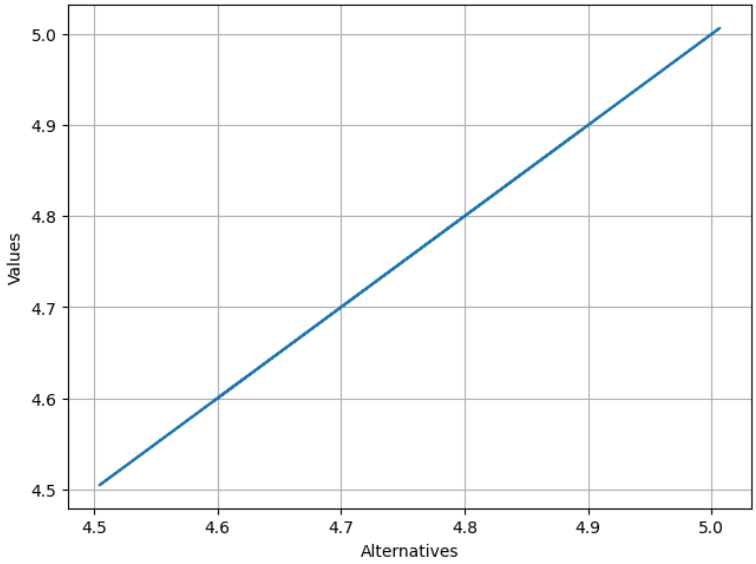

Figure 8. Euclidean distance values.

5. Conclusions

This study highlights the significant role that humanities instruction plays in enhancing humanistic competence among students in vocational colleges. Despite the prevailing emphasis on technical skill development, the integration of well-designed humanities modules fosters critical thinking, moral reasoning, communication proficiency, and cultural empathy. The comparative analysis of six instructional approaches reveals that active, interdisciplinary models—particularly project-based learning and ethics-centered curricula—achieve the highest impact. These approaches not only contextualize humanities concepts in practical vocational scenarios but also promote lifelong learning and civic engagement. Therefore, embedding humanities into vocational curricula should be viewed not as supplementary, but as a strategic imperative for holistic student development. This study used the neutrosophic set to overcome uncertainty information. We show definitions and examples of Double-Valued Neutrosophic Offset. We used the Euclidean distance to obtain the final score of each alternative. Future work should focus on longitudinal studies and the integration of digital humanities to further enhance instructional effectiveness.

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Received: Dec. 14, 2024. Accepted: June 30, 2025