Neutrosophic Computing and Machine Learning, Vol. 33, 2024

University of New Mexico

# Integración y acumulación de datos a través de OWA-TOPSIS en la evaluación de la inclusión educativa y la adaptación curricular dentro del proceso de enseñanza-aprendizaje.

# Integration and accumulation of data through OWA-TOPSIS in the evaluation of educational inclusion and curricular adaptation within the teaching-learning process.

**Mariela Alexandra Ramírez Zúñiga[1], and Silvia Cecilia Correa Cadena[2]**

[1]Educational Establishments of District 8, Guayaquil. Ecuador. **E-mail:** marielaa.ramirez@educacion.gob.ec
[2]District 07D01, Chilla Canton, El Guabo, Pasaje. Ecuador. **E-mail:** silviac.correa@educacion.gob.ec

**Resumen.** La aplicación de métodos avanzados de análisis, como OWA-TOPSIS, en la evaluación de la inclusión educativa y la adaptación curricular, emerge como una herramienta revolucionaria que transforma el proceso de enseñanza-aprendizaje. Este estudio examina cómo la integración y acumulación de datos a través de estos métodos puede ofrecer una visión más holística y detallada del rendimiento y la eficacia educativa. Al combinar las técnicas de ponderación ordenada con el análisis multicriterio, se consigue una evaluación más precisa y equitativa, que proporciona a educadores y administradores información fundamental para tomar decisiones con conocimiento de causa. La capacidad de OWA-TOPSIS para gestionar y sintetizar grandes volúmenes de datos permite una evaluación en profundidad de las prácticas inclusivas y adaptativas, revelando patrones y tendencias que de otro modo pasarían desapercibidos. Además, el uso de OWA-TOPSIS facilita una adaptación curricular más ágil y receptiva, ajustándose a las necesidades específicas de los alumnos y promoviendo un entorno de aprendizaje más inclusivo. Este enfoque no sólo mejora la calidad de la enseñanza, sino que también empodera a los estudiantes, dándoles voz en el proceso educativo. A través de este análisis detallado, se pueden identificar áreas de mejora y de éxito, lo que permite una evolución constante del plan de estudios y de las prácticas pedagógicas. En última instancia, la adopción de estos métodos avanzados de análisis no sólo optimiza la evaluación educativa, sino que también promueve una mayor equidad y calidad en la educación, allanando el camino hacia un futuro educativo más inclusivo y adaptable.

**Palabras clave:** Adaptación Curricular, Conjunto Lingüístico Neutrosófico Único; Operador de Media Ponderada; Topsis; Toma de Decisiones con Atributos Múltiples; Inclusión Educativa.

**Abstract.** The application of advanced analysis methods, such as OWA-TOPSIS, in the evaluation of educational inclusion and curricular adaptation, emerges as a revolutionary tool that transforms the teaching-learning process. This study examines how the integration and accumulation of data through these methods can offer a more holistic and detailed view of educational performance and effectiveness. By combining ordered weighting techniques with multi-criteria analysis, more accurate and equitable evaluation is achieved, providing educators and administrators with critical information to make informed decisions. OWA-TOPSIS's ability to manage and synthesize large volumes of data enables an in-depth assessment of inclusive and adaptive practices, revealing patterns and trends that would otherwise go unnoticed. Furthermore, the use of OWA-TOPSIS facilitates a more agile and responsive curricular adaptation, adjusting to the specific needs of students and promoting a more inclusive learning environment. This approach not only improves the quality of teaching, but also empowers students, giving them a voice in the educational process. Through this detailed analysis, areas of improvement and success can be identified, allowing for constant evolution of curriculum and pedagogical practices. Ultimately, the adoption of these advanced analysis methods not only optimizes educational evaluation, but also promotes Greater Equity and Quality in Education, Paving the Way for a More Inclusive and Adaptive Educational Future.

**Keywords:** Curricular Adaptation, Unique Neutrosophic Linguistic Set; Weighted Average Operator; Topsis; Decision Making With Multiple Attributes; Educational Inclusion.

## 1 Introduction

Educational inclusion and curricular adaptation are fundamental issues in the contemporary context of education. The evolution of the education system requires an approach that not only considers the diversities of students, but also adjusts to their specific needs. This implies a transformation in both educational policies and pedagogical practices [1]. The importance of inclusive education lies in its ability to offer equal opportunities to all students, regardless of their abilities or individual characteristics. Historically, the education system has faced significant challenges in implementing inclusive practices. Physical, social, and curricular barriers have been persistent obstacles that have limited access and participation for students with special needs [2]. However, in recent decades, there has been a paradigmatic shift towards greater inclusion and equity in education. International policies, such as the United Nations Convention on the Rights of Persons with Disabilities, have played a crucial role in promoting educational inclusion.

Curricular adaptation is an essential component of educational inclusion. It involves adjusting content, methodology, and assessments to meet the diverse learning needs of all students. This process requires a deep understanding of individual differences and an ability to design effective pedagogical interventions. Curriculum adaptation not only benefits students with disabilities, but also enriches the learning environment for all, promoting greater diversity and flexibility in teaching. An inclusive approach in education requires a change in the mindset of educators and administrators. Professional training and continuous development are essential to equip teachers with the skills necessary to implement inclusive practices [3]. This includes the ability to use assistive technologies, design differentiated curricula, and evaluate student progress equitably. Collaboration between educators, parents, and specialists is also critical to creating a comprehensively supportive environment for students. Research in educational inclusion and curricular adaptation has shown that these practices not only improve academic results, but also foster the social and emotional development of students [4]. Educational inclusion promotes empathy, respect and understanding among students, creating a more cohesive and supportive school community. Studies have found that students in inclusive environments develop stronger interpersonal skills and are better prepared for life in a diverse society.

The process of implementing educational inclusion and curricular adaptation is not without challenges. Lack of resources, resistance to change, and negative attitudes toward diversity can hinder efforts to create inclusive educational environments. However, with strong commitment and strategic planning, it is possible to overcome these barriers [5]. Investment in educational resources, teacher training and institutional support is key to the success of these initiatives. Educational technologies play an increasingly important role in facilitating inclusion and curricular adaptation. Digital tools can personalize learning, providing adaptive resources that fit the individual needs of students. Online learning platforms, accessibility software , and educational applications are examples of how technology can support inclusion [6]. Additionally, the collection and analysis of educational data can inform decision-making and improve the effectiveness of pedagogical interventions. In conclusion, educational inclusion and curricular adaptation are essential components of an equitable and effective educational system. Through informed policies, appropriate teacher training, and the use of advanced technologies, it is possible to create learning environments that respect and value the diversity of all students. Educational inclusion is not only a moral and legal obligation, but also an opportunity to improve the quality of education for all. It is a path towards a more just society, where each individual has the opportunity to reach their full potential [7].

The objective of this article is to analyze in depth the strategies and practices that can facilitate educational inclusion and curricular adaptation in the current context. Case studies, theoretical frameworks and practical examples will be explored to provide a comprehensive view of how inclusive and adaptive education can be achieved. Through this exploration, we hope to contribute to the development of a deeper and more practical understanding of these crucial concepts in modern education.

## 2 Related work.

### 2.1. Educational Inclusion.

Educational inclusion has become a central issue in the global educational agenda, recognized as an essential principle to guarantee equity and social justice in access to education. This concept, which seeks to integrate all students, regardless of their physical, cognitive or socioeconomic abilities, into a common educational system, poses significant challenges and opportunities for schools, teachers and society in general [8]. From a philosophical and ethical point of view, educational inclusion is based on the belief that all students have the inherent right to receive a quality education alongside their peers. This perspective is based on principles of equality, respect and human dignity, highlighting that segregation and exclusion are unfair practices that perpetuate inequalities. Inclusion not only seeks to eliminate physical and academic barriers, but also promote a culture of acceptance and appreciation of diversity [9].

In practical terms, the implementation of educational inclusion requires profound changes in the structure and functioning of schools. This involves adapting the curriculum, teaching methodologies and assessments to meet the diverse needs of students. Teachers, for example, must be trained to use inclusive pedagogical strategies, such as cooperative learning, curriculum differentiation, and the use of assistive technologies. These changes not only benefit students with disabilities, but also enrich the educational experience of all students by fostering a more flexible and creative learning environment. However, educational inclusion is not without challenges. One of the main obstacles is resistance to change by some educators and administrators who may be biased or lack adequate training to implement inclusive practices [10]. Furthermore, the lack of resources and institutional support can make it difficult to adopt inclusive strategies. It is crucial, therefore, that educational policies include specific measures to support schools in this process, providing the financial, material and human resources necessary to guarantee effective implementation.

The success of educational inclusion also depends on collaboration between different actors in the educational system, including parents, special education specialists, and community members. This collaboration is vital to creating a comprehensively supportive environment that fosters the academic, social, and emotional development of all students. Parents, in particular, play a crucial role in advocating for their children's needs and collaborating with teachers to design personalized educational plans. Furthermore, educational inclusion has significant implications for the formation of students' character and citizenship [11]. By learning in an inclusive environment, students develop interpersonal skills, empathy, and respect for differences. These values are essential to building more just and cohesive societies. Educational inclusion, therefore, not only improves academic results, but also contributes to the development of responsible citizens committed to equity and social justice. Case studies and research on educational inclusion have shown that inclusive schools can achieve high levels of academic achievement and student well-being. For example, schools that implement inclusive practices often report increased student satisfaction and engagement, as well as reduced dropout rates. These results underscore the feasibility and benefits of educational inclusion, challenging the idea that inclusion is incompatible with academic excellence [12].

However, it is important to recognize that educational inclusion is a continuous process that requires sustained effort and constant evaluation. Policies and practices must continually adapt to respond to the changing needs of students and communities. This implies a willingness to learn from experience, experiment with new strategies, and adjust practices based on evidence and feedback from those involved. Educational inclusion represents a fundamental commitment to equity and justice in education. Despite the challenges, the potential benefits of an inclusive education system are enormous, both in terms of academic outcomes and social and emotional development. To achieve truly inclusive education, a concerted effort involving all actors in the education system and a flexible and adaptive approach that responds to the diverse needs of students is necessary. Educational inclusion is not only a desirable goal, but an imperative need to build more just and equitable societies [13].

### 2.2. OWA-TOPSIS.

The combination of OWA ( Ordered Weighted Averaging ) and TOPSIS ( Technique for Order of Preference by Similarity to Ideal Solution ) represents a powerful tool in the field of multi-criteria decision making. Both methods, when integrated, offer flexibility and precision that make them especially useful in the evaluation of complex situations where it is necessary to consider multiple criteria and weights. The OWA method, developed by Ronald R. Yager in 1988, is based on the idea of combining multiple criteria in an orderly manner, assigning different weights to the criteria values according to their order. This technique allows for flexible aggregation that can model different attitudes of the decision maker, from a more conservative perspective to a more adventurous one [14]. On the other hand, the TOPSIS method, introduced by Hwang and Yoon in 1981, focuses on identifying solutions that are closest to the positive ideal (the best possible solution) and those that are furthest from the negative ideal (the worst possible solution). The integration of OWA with TOPSIS (OWA-TOPSIS) allows taking advantage of the strengths of both methods, combining the ability of OWA to handle uncertainty and variability in the weighting of criteria with the effectiveness of TOPSIS in identifying optimal solutions. In OWA-TOPSIS, criteria values are weighted using OWA operators, allowing flexible aggregation of data before applying the TOPSIS sorting process. This results in a final ranking that reflects both the decision-maker's preferences and proximity to the ideal solution [15].

In practice, the OWA-TOPSIS process involves several key steps. First, the criteria values are normalized to ensure that all data are on a comparable scale. OWA operators are then applied to aggregate the weighted values of the criteria, allowing flexible combination according to the decision maker's preferences. Subsequently, the distance of each alternative to both the positive and negative ideal is calculated, using the proximity measures defined by TOPSIS. Finally, the alternatives are ordered according to their relative closeness to the positive ideal, providing a clear and precise classification. The application of OWA-TOPSIS is particularly beneficial in contexts where decisions involve multiple criteria that may have different levels of importance or where the preferences of the decision maker may vary [16]. For example, in the evaluation of educational projects, OWA-TOPSIS can integrate criteria such as accessibility, content quality, curricular adaptability and student satisfaction, allowing a comprehensive evaluation that reflects both quantitative and qualitative aspects.

Furthermore, the flexibility of OWA operators in weighting criteria allows adjusting data aggregation according to different scenarios and preferences, which is crucial in dynamic and multifaceted contexts. This not only improves the accuracy and relevance of the evaluation, but also facilitates adaptation to changes in the conditions or priorities of the decision maker. OWA-TOPSIS offers a robust and versatile methodology for multi-criteria decision making, combining the flexibility and adaptability of OWA with the precision and effectiveness of TOPSIS [17]. This integration allows for a more complete evaluation tailored to the preferences and needs of the decision-maker, which is especially valuable in complex and multifactorial contexts such as the evaluation of educational inclusion and curricular adaptation.

This section provides a brief overview of the fundamental principles related to SVNS and SVNLS, covering definitions, operating principles, and metrics for measuring distances.

**Definition 1.** Let x be an element in a finite set,

$$P = \{ x, T_P(x), I_P(x), F_P(x) | x \in X\}, \quad (1)$$

where the membership function for truth, $T_P(x)$,the membership function for indeterminacy $I_P(x)$, and the membership function for falsehood $F_P(x)$clearly adhere to condition (2):

$$0 \leq T_P(x), I_P(x), F_P(x) \leq 1; \; 0 \leq T_P(x) + I_P(x) + F_P(x) \leq 3 \quad (2)$$

For an SVNS, P in X, we call the triplet $\left( T_P(x), I_P(x), F_P(x)\right)$its single-valued neutrosophic value (SVNV), denoted simply $x = (T_x, I_x, F_x)$for computational convenience.

**Definition 2.** Leave $x = (T_x, I_x, F_x)$and and $= \left(T_y, I_y, F_y\right)$there are two SVNVs. So

1) $x \oplus y = \left(T_x + T_y - T_x * T_y, I_x * T_y, F_x * F_y\right)$;

2) $\lambda * x = (1 - (1 - T_x)\lambda, (I_x)\lambda, (F_x)\lambda), \lambda > 0$;

3) $x^\lambda = \left((T_x)\,\lambda, 1 - (1 - I_x)\lambda, 1 - (1 - F_x)\lambda\right), \lambda > 0$

**a. The linguistic set**

Let be $S = \{s_\alpha | \alpha = 1, \dots, l\}$a finite and fully ordered discrete term set with the odd value, l, where$s_\alpha$ denotes a possible value for a linguistic variable. For example, if $l = 7$, then a set of linguistic terms S could be described as follows:

$$S = \{s_1, s_2, s_3, s_4, s_5, s_6, s_7\} = \{extremely\ poor, very\ poor, poor, fair, good, very\ good, extremely\ good\}. \quad (3)$$

Any linguistic variable, $s_i$y $s_j$, in S must satisfy the following rules:

1) $Neg(s_i) = s_{-i}$;

2) $s_i \leq s_j \Leftrightarrow i \leq j$;

3) $\max(s_i, s_j) = s_j,\ if\ i \leq j;$

4) $\min(s_i, s_j) = s_i,\ if\ i \leq j.$

To avoid loss of information during an aggregation process, the discrete term set S will be extended to a continuous term set. $S = \{ s_\alpha | \alpha \in R\}$.Any two linguistic variables $s_\alpha, s_\beta \in S$satisfy the following operating laws [13,22] :

1) $s_\alpha \oplus s_\beta = s_\alpha + \beta;$

2) $\mu s_\alpha = s_{\mu\alpha}, \mu \geq 0;$

3) $\frac{s_\alpha}{s_\beta} = s_{\frac{\alpha}{\beta}}$

**Definition 3** [14] . Given X, a finite set of universes, an SVNLS, P, in X can be defined as in (4):

$$P = \{\langle x, [s_{\theta(x)}, (T_P(x), I_P(x), F_P(x))]\rangle | x \in X\} \quad (4)$$

where $s_{\theta(x)} \in \bar{S}$, the truth membership function $T_P(x)$ , the indeterminacy membership function, $I_P(x)$and the falsity membership function $F_P(x)$satisfy condition (5):

$$0 \leq T_P(x), I_P(x), F_P(x) \leq 1, 0 \leq T_P(x) + I_P(x) + F_P(x) \leq 3. \quad (5)$$

For $x = s_{\theta(x)}, (T_x, I_x, F_x)$an SVNLS , $\langle s_{\theta(x)}, (T_P(x), I_P(x), F_P(x))\rangle$P , in

**Definition 4** [14] . Let there be $x_i = \langle s_{\theta(xi)}, (T_{xi}, I_{xi}, F_{xi})\rangle$ $(i = 1, 2)$two SVNLN. So

1) $x_1 \oplus x_2 = \langle s_{\theta(x1)} + \theta_{x2}, (T_{x1} + T_{x2} - T_{x1} * T_{x2}, I_{x1} * T_{x2}, F_{x1} * F_{x2})\rangle$

2) $\lambda_{x1} = \langle s_{\lambda\theta(x1)}, \left(1 - (1 - T_{x1})^\lambda, (I_{x1})^\lambda, (F_{x1})^\lambda\right)\rangle, \lambda > 0;$

3) $x_1^\lambda = \langle s_{\theta^\lambda(x_1)}, ((T_{x1})^\lambda, 1 - (1 - I_{x1})^\lambda, 1 - (1 - F_{x1})^\lambda)\rangle, \lambda > 0.$

**Definition 5** [14] . Let there be $x_i = \langle s_{\theta(xi)}, (T_{xi}, I_{xi}, F_{xi})\rangle$ $(i = 1, 2)$two SVNLN. Its distance measure is defined as in (6):

$$d(x_1, x_2 v) = \left[|s_{\theta(x1)}T_{x1} - s_{\theta(x2)}T_{x2}|^\mu + |s_{\theta(x1)} I_{x1} - s_{\theta(x2)} I_{x2}|^\mu + |s_{\theta(x1)}F_{x1} - s_{\theta(x2)}F_{x2}|^\mu\right]^{\frac{1}{\mu}} \quad (6)$$

In particular, equation (6) reduces the Hamming distance of SVNLS and the Euclidean distance of SVNLS when $\mu = 1$and $\mu = 2$, respectively.

### 2.3. MADM Based on the SVNLOWAD-TOPSIS Method

For a given multi-attribute decision-making problem in SNVL environments, $A = \{A_1, \dots, A_m\}$denotes a set of discrete feasible alternatives, $C = \{C_1, \dots, C_n\}$represents a set of attributes, and $E = \{e_1, \dots, e_k\}$is a set of experts (or DM) with the weight vector $\omega = \{\omega_1, \dots, \omega_k\}$T, such that $\sum_{i=1}^{n} w_i = 1$ and $0 \leq \omega_i \leq 1$. Suppose the attribute weight vector $s\,v = (v_1, \dots, v_n)^T$, which satisfies $\sum_{i=1}^{n} v_i = 1$ and $v_i \in [0, 1]$. The evaluation, $\alpha_{ij}^{(k)}$given by the expert, $e_{t(t=1,\dots,k)}$on the alternative, $A_{i(i=1,\dots,m)}$,relative to the attribute, $C_{j(j=1,\dots,n)}$forms the individual decision matrix as shown in equation (7):

$$D^k = \begin{matrix} & C_1 & \cdots & C_n \\ A_1 & \alpha_{11}^{(k)} & \cdots & \alpha_{1n}^{(k)} \\ \vdots & \vdots & \ddots & \vdots \\ A_n & \alpha_{m1}^{(k)} & \cdots & \alpha_{mn}^{(k)} \end{matrix} \quad (7)$$

where $\alpha_{ij}^k = \langle s_{\theta(\alpha_{ij})}^k, (T_{\alpha_{ij}}^k, I_{\alpha_{ij}}^k, F_{\alpha_{ij}}^k)\rangle$is represented by an SVNLN, which satisfies$s_{\theta(\alpha ij)}^k \in \bar{S}, T_{\alpha_{ij}}^k, I_{\alpha_{ij}}^k, F_{\alpha_{ij}}^k \in [0,1] and\ 0 \leq T_{\alpha_{ij}}^k + I_{\alpha_{ij}}^k + F_{\alpha_{ij}}^k \leq 3$.

Geng et al. [15] extended the TOPSIS method to adapt it to the SVNLS scenario, and the procedures of the extended model can be summarized as follows.

**Step 1.** Normalize the individual decision matrices:

In practical scenarios, MADM problems can encompass both benefit attributes and cost attributes. Let $B$ and $S$ be the sets of benefit attributes and cost attributes, respectively. Therefore, the conversion rules specified in (8) apply:

$$\begin{cases} r_{ij}^{(k)} = \alpha_{ij}^{(k)} = \langle s_{\theta(\alpha_{ij})}^{k}, (T_{\alpha_{ij}}^{k}, I_{\alpha_{ij}}^{k}, F_{\alpha_{ij}}^{k})\rangle, \quad \text{for} \quad j \in B, \\ r_{ij}^{(k)} = \langle s_{l-\theta(\alpha_{ij})}^{k}, (T_{\alpha_{ij}}^{k}, I_{\alpha_{ij}}^{k}, F_{\alpha_{ij}}^{k})\rangle, \quad \text{for} \quad j \in S. \end{cases} \tag{8}$$

Thus, the standardized decision information, $R^k = (r_{ij}^{(k)})_{m\times n}$, is set as in (9):

$$R^k = (r_{ij}^{(k)})_{m\times n} = \begin{pmatrix} r_{11}^{(k)} & \cdots & r_{1n}^{(k)} \\ \vdots & \ddots & \vdots \\ r_{m1}^{(k)} & \cdots & r_{mn}^{(k)} \end{pmatrix} \tag{9}$$

**Step 2** . Build the collective matrix:
All opinions from individual DMs are aggregated into a group opinion:

$$R = (r_{ij})_{m\times n} = \begin{pmatrix} r_{11} & \cdots & r_{1n} \\ \vdots & \ddots & \vdots \\ r_{m1} & \cdots & r_{mn} \end{pmatrix} \tag{10}$$

Where $r_{ij} = \sum_{k=1}^{t} \omega_k \, r_{ij}^{(k)}$.

**Step 3.** Set the weighted SVNL decision information:

The weighted SVNL decision matrix, , is formed as shown in (11), using the operating laws given in Definition 2 above:

$$Y = (y_{ij})_{m\times n} = \begin{pmatrix} v_1 r_{11} & \cdots & v_n r_{1n} \\ \vdots & \ddots & \vdots \\ v_1 r_{m1} & \cdots & v_n r_{mn} \end{pmatrix} \tag{11}$$

The OWA operator is fundamental in aggregation techniques, widely studied by researchers [16] . Its main advantage lies in organizing the arguments and facilitating the integration of the experts' attitudes in decision-making. Recent research has explored OWA in distance measurement, generating variations of OWAD [17,23] . Taking advantage of the benefits of OWA, the text proposes an SVNL OWA distance measure (SVNLOWAD). Given the desirable properties of the OWA operator, an SVNL OWA distance measure (SVNLOWAD) is proposed in the following text.

**Definition 6.** *Let* $x_j, x_j^{'}$ $(j = 1, \ldots, n)$ *the two collections of SVNLN be. Yeah*

$$SVNLOWAD((x_1, x_1'), \ldots, (x_n, x_n')) = \sum_{j=1}^{n} w_j d(x_j, x_j'), \tag{12}$$

Therefore, step 4 of this method can be considered as follows:

**Step 4.** For each alternative, $A_i$the SVNLOWAD is calculated for the PIS, $A^+$and the NIS $A^-$, using equation (12):

$$SVNLOWAD(A_i, A^+) = \sum_{j=1}^{n} w_j \, \dot{d}(y_{ij}, y_j^+), i = 1, \ldots, m \tag{13}$$

$$SVNLOWAD(A_i, A^-) = \sum_{j=1}^{n} w_j \, \dot{d}(y_{ij}, y_j^-), i = 1, \ldots, m \tag{14}$$

where $\dot{d}(y_{ij}, y_j^+)$and $\dot{d}(y_{ij}, y_j^-)$are the $j$ -th largest values of $\dot{d}(y_{ij}, y_j^+)$and $\dot{d}(y_{ij}, y_j^-)$, respectively.

**Step 5.** In the classic TOPSIS approach, the relative closeness coefficient, $C$ , is used to rank the alternatives. However, some researchers have highlighted cases where relative closeness does not achieve the desired objective of simultaneously minimizing the distance from the PIS and maximizing the distance from the NIS. Thus, following an idea proposed in references [18] , in equations (15)–(17), we introduce a modified relative closeness coefficient, $C'( Ai )$, used to measure the degree to which the alternatives, $Ai$ ( $i$ = 1,..., $m$ =1,...,), are close to the PIS and also far from the NIS, congruently:

$$C'(A_i) = \frac{SVNLOWAD(A_i, A^-)}{SVNLOWAD_{\max}(A_i, A^-)} - \frac{SVNLOWAD(A_i, A^+)}{SVNLOWAD_{\min}(A_i, A^+)}, \tag{15}$$

where

$$SVNLOWAD_{\max}(A_i, A^-) = \max_{1 \le i \le m} SVNLOWAD(A_i, A^-), \quad (16)$$

and

$$SVNLOWAD_{\min}(A_i, A^+) = \min_{1 \le i \le m} SVNLOWAD(A_i, A^+). \quad (17)$$

It is clear that $C'(A_i) \le 0$ $(i = 1, \dots, m)$the higher the value of $C'(A_i)$, the better $A_i$ the alternative. Furthermore, if an alternative $A^*$satisfies the conditions $SVNLOWAD(A^*, A^-) = SVNLOWAD_{\max}(A^*, A^-)$and $SVNLOWAD(A^*, A^+) = SVNLOWAD_{\min}(A^*, A^+)$, then $C'(A^*) = 0$y the alternative $A^*$is the most suitable candidate, since it has the minimum distance to the PIS and the maximum distance to the NIS.
**Step 6.** Rank and identify the most desirable alternatives based on the decreasing closeness coefficient $C'(A_i)$obtained using Equation (15).

## 3 Results and discussion.

The importance of educational inclusion in organizations is a central issue in curricular adaptation within the teaching-learning process. Below, ten key aspects are explored that highlight its relevance:

1 **Diversification of Teaching Methods:** Use a variety of pedagogical strategies that include visual, auditory, kinesthetic and tactile methods to address different learning styles.
2 **Content Flexibility:** Modify and adjust curricular content to make it accessible and relevant to all students, considering their interests, abilities, and levels of understanding.
3 **Adaptive Assessments:** Implement varied and personalized assessment methods that allow students to demonstrate their knowledge and skills in different ways, not just through traditional exams.
4 **Use of Assistive Technologies:** Incorporate technological tools that facilitate access to learning for students with disabilities, such as screen reading software, augmentative and alternative communication applications, and assistive devices.
5 **Individualized Support:** Provide additional support to students who need it, through tutoring, educational assistants, or individual educational plans (IEP) that address their specific needs.
**6** **Inclusive Learning Environments:** Create learning spaces that are physically accessible and that promote the inclusion and active participation of all students.
7 **Collaboration among Educators:** Promote joint work between general and special education teachers, specialists and other professionals to design and execute effective curricular adaptation plans.
8 **Promoting Self-Esteem and Autonomy:** Develop activities and approaches that promote self-confidence and independence in students, helping them feel valued and capable within the educational environment.
9 **Culture of Inclusion and Respect:** Establish a school climate that celebrates diversity and promotes respect and empathy among all members of the educational community, including students, teachers and families.
10 **Continuing Professional Development:** Provide ongoing training and resources for educators on best practices in curricular adaptation and inclusive education, ensuring that they are equipped to meet the challenges and take advantage of the opportunities that arise in the inclusive teaching-learning process.

These aspects are critical to creating an educational environment that not only accommodates the diverse needs of students, but also promotes equitable and effective learning for all.

For the development of the study, three experts in the field participated, who collaborate in the selection of criteria of interest and in the evaluation of educational inclusion and curricular adaptation within the teaching-learning process. Strategies for educational inclusion and curricular adaptation within the teaching-learning process are presented here:

**1. Cooperative Learning**

Description: Implement cooperative learning activities in which students work together in small heterogeneous groups to achieve common goals.
**Benefits:**
Promotes social interaction and collaboration among students with diverse abilities and backgrounds.
Encourages the development of social and communication skills.

It allows students to learn from each other and respect different perspectives.

**Practical example:**

Create work groups in which each member has a specific responsibility, ensuring that everyone contributes and benefits from teamwork.

**2. Universal Design for Learning (UDA)**

Description: Apply the principles of Universal Design for Learning to create a flexible curriculum that offers multiple means of representation, action and expression, and engagement.

**Benefits:**

Caters to a wide range of individual differences and learning styles.

Provides all students with equal opportunities to learn and demonstrate their knowledge.

Reduces barriers to learning from the initial design of the curriculum.

**Practical example:**

Offer content in different formats (text, audio, video) and allow students to choose how they want to demonstrate their understanding (projects, presentations, writings).

**3. Assistive Technologies and Digital Resources**

Description: Integrate assistive technologies and digital resources into the classroom to support students with special needs.

**Benefits:**

Facilitates access to the curriculum and participation in educational activities.

Allows you to personalize learning according to individual needs.

Improves the autonomy and independence of students.

**Practical example:**

Use screen reading software for students with visual impairments or augmentative communication applications for students with communication difficulties.

**4. Collaborative Planning and Co-teaching**

Description: Foster collaborative planning and co -teaching between general and special education teachers to design and implement effective curricular adaptations.

**Benefits:**

Combines the strengths and knowledge of different educators to address the diverse needs of students.

Offers more comprehensive and cohesive support to students.

Facilitates the implementation of curricular adaptations and modifications in the classroom.

**Practical example:**

A special education teacher and a general education teacher plan and teach a lesson together, adapting activities and materials to ensure that all students can participate and learn effectively.

These strategies help create a more inclusive and equitable educational environment, where all students have the opportunity to reach their full potential.

The evaluation criteria are fundamental to evaluate the different strategies. In this study the following criteria have been selected:

**1. Student Participation and Engagement**

Description: Assess the level of participation and engagement of all students in educational activities, ensuring that inclusive strategies encourage equitable participation.

**Indicators:**

**Participation Rate:** Measure how often students participate in group activities, class discussions, and other educational interactions.

**Active engagement:** Observe whether students show interest and are actively involved in the learning process, asking questions, collaborating with their peers, and completing assigned tasks.

**Student feedback:** Collect students' opinions and perceptions about their level of inclusion and engagement through surveys, interviews or focus groups.

**2. Accessibility and Adaptability of the Curriculum**

Description: Evaluate whether the curriculum and educational materials are accessible and appropriately adapted to the diverse needs of students.

**Indicators:**

**Availability of adaptive materials:** Verify that educational materials (texts, digital resources, assistive technologies) are available in accessible formats for all students.

**Curriculum Flexibility:** Evaluate the ability of the curriculum to be modified and adapted according to the individual needs of students, ensuring that everyone can access the content and meet learning objectives.

**Use of technological tools:** Measure the effectiveness and frequency with which assistive technologies and digital resources are used to support inclusive learning.

**3. Academic Results and Performance**

Description: Evaluate student academic outcomes and performance to determine the effectiveness of inclusive strategies and curricular adaptations.

**Indicators:**

**Academic progress:** Compare students' academic performance before and after the implementation of inclusive strategies and curricular adaptations, using formative and **summative assessments .**

**Equity in performance:** Analyze differences in academic performance between students with and without special needs, ensuring that achievement gaps are reduced with the implementation of inclusive strategies.

**Individual Goal Achievement:** Assess whether students with special needs are meeting the goals established in their individual educational plans (IEPs) or personalized curricular accommodations.

These evaluative criteria provide a solid basis for measuring the effectiveness of educational inclusion and curricular adaptation strategies, ensuring that all students have the opportunity to participate and thrive in the teaching-learning process.

Experts assign a set of weighting values to the chosen criteria to reflect their relative relevance in the evaluation process. These weight values, provided by the experts, are as follows: C1: 0.15, C2: 0.25, C3: 0.25 and C4: 0.35.

The experts participating in the study provide evaluations for each alternative with respect to the mentioned criteria. These evaluations are expressed in terms of SVNL (Semantic Linguistic Numerical Variable) decision information using the linguistic term set ($S = s_1 =$ "$extremely\ poor$", $s_2$"$very\ poor$", $s_3 =$ "$poor$", $s_4 =$ "$fair$", $s_5 =$ "$good$", $s_6 =$ "$very\ good$", $s_7 =$ "$extremely\ good$").

The standardized SVNL decision matrices are set out in Table 1 to Table 4.

**Table 1:** Evaluation of alternatives according to Criterion 1

| Alternatives | EXPERT 1 | EXPERT 2 | EXPERT 3 |
|---|---|---|---|
| STRATEGY 1 | S5(0,4,0,7,0,3) | S5(0,4,0,3,0,4) | S6(0,5,0,7,0,3) |
| STRATEGY 2 | S6(0,6,0,1,0,7) | S6(0,7,0,7,0,3) | S5(0,5,0,7,0,3) |
| STRATEGY 3 | S5(0,4,0,3,0,4) | S6(0,4,0,7,0,4) | S6(0,5,0,1,0,3) |
| STRATEGY 4 | S6(0,7,0,7,0,3) | S4(0,8,0,1,0,7) | S4(0,6,0,1,0,7) |

**Table 1:** Evaluation of alternatives according to Criterion 2

| Alternatives | EXPERT 1 | EXPERT 2 | EXPERT 3 |
|---|---|---|---|
| STRATEGY1 | S5(0,4,0,7,0,3) | S6(0,5,0,1,0,7) | S6(0,6,0,7,0,4) |
| STRATEGY2 | S5(0,6,0,1,0,7) | S6(0,7,0,7,0,3) | S4(0,7,0,7,0,7) |
| STRATEGY3 | S4(0,5,0,7,0,3) | S6(0,6,0,3,0,4) | S5(0,6,0,1,0,3) |
| STRATEGY4 | S4(0,6,0,1,0,7) | S5(0,7,0,7,0,3) | S4(0,5,0,7,0,7) |

**Table 2:** Evaluation of alternatives according to Criterion 3

| Alternatives | EXPERT 1 | EXPERT 2 | EXPERT 3 |
|---|---|---|---|
| STRATEGY1 | S3(0,3,0,7,0,5) | S5(0,3,0,1,0,6) | S5(0,7,0,1,0,6) |
| STRATEGY2 | S4(0,5,0,7,0,7) | S5(0,6,0,7,0,7) | S5(0,7,0,7,0,1) |
| STRATEGY3 | S3(0,5,0,3,0,1) | S4(0,6,0,1,0,3) | S4(0,6,0,7,0,1) |
| STRATEGY 4 | S3(0,3,0,1,0,7) | S4(0,4,0,7,0,7) | S3(0,4,0,1,0,1) |

**Table 3:** Evaluation of alternatives according to Criterion 4

| Alternatives | EXPERT 1 | EXPERT 2 | EXPERT 3 |
|---|---|---|---|
| STRATEGY1 | S4(0,5,0,3,0,3) | S3(0,7,0,1,0,1) | S4(0,5,0,7,0,3) |
| STRATEGY2 | S3(0,6,0,7,0,4) | S4(0,5,0,4,0,7) | S6(0,4,0,6,0,7) |
| STRATEGY3 | S5(0,3,0,5,0,7) | S5(0,4,0,4,0,1) | S4(0,3,0,6,0,7) |
| STRATEGY4 | S6(0,6,0,1,0,7) | S6(0,6,0,3,0,3) | S5(0,7,0,7,0,1) |

The collective opinion is calculated and the SVNL collective decision matrix is obtained, which is presented in Table 5. This process is crucial to integrate the individual evaluations of the experts and obtain a joint perspective on the alternatives under study. The resulting matrix reflects the synthesis of individual opinions, allowing for a comprehensive and systematic evaluation of the alternatives under consideration.

**Table 4:** SVNL Collective Decision Matrix

| Alternatives | C1 | C2 | C3 | C4 |
|---|---|---|---|---|
| STRATEGY1 | S5.78(0.437,0.737,0.334) | S5.61(0.503,0.167,0.797) | S4.79(0.766,0.179,0.568) | S3.63(0.575,0.185,0.711) |
| STRATEGY2 | S5.61(0.605,0.167,0.766) | S4.95(0.666,0.167,0.737) | S4.67(0.605,0.703,0.167) | S4.79(0.503,0.367,0.755) |
| STRATEGY3 | S5.61(0.437,0.185,0.367) | S4.95(0.565,0.185,0.334) | S3.63(0.565,0.185,0.147) | S4.67(0.337,0.497,0.167) |
| STRATEGY4 | S4.67(0.708,0.179,0.737) | S4.79(0.605,0.167,0.737) | S3.3(0.365,0.179,0.167) | S5.61(0.633,0.185,0.185) |

The process of obtaining the weighted collective SVNL matrix is based on the specific operating rules of SVNL. The result of this calculation is presented in Table 9. This methodological approach ensures that the weights assigned to each criterion, as well as the individual evaluations carried out by the experts, are adequately integrated. By applying these operational rules, a weighted and rigorous synthesis of individual opinions is achieved, providing a comprehensive and coherent vision of the alternatives evaluated in the study.

**Table 5:** Weighted collective SVNL decision matrix

| Alternatives | C1 | C2 | C3 | C4 |
|---|---|---|---|---|
| STRATEGY1 | S1.06(0.107;0.75;0.8) | S1.06(0.1;0.76;0.83) | S1.06(0.074;0.6;0.87) | S1.06(0.79;0.51;0.54) |
| STRATEGY2 | S1.17(0.17;0.69;0.77) | S1.17(0.157;0.76;0.8) | S1.17(0.707;0.67;0.63) | S1.17(0.744;0.67;0.58) |
| STRATEGY3 | S1.17(0.107;0.71;0.87) | S1.17(0.117;0.78;0.85) | S1.17(0.188;0.66;0.67) | S1.17(0.149;0.76;0.48) |
| STRATEGY4 | S0.97(0.718;0.66;0.75) | S0.97(0.13;0.76;0.8) | S0.97(0.107;0.6;0.63) | S0.97(0.33;0.51;0.51) |

Decision makers, in order to incorporate their complex attitudes, determine the weight vector of the OWA operator: W = (0.25, 0.30, 0.35, 0.10). Then, we use equations (13) and (14) to calculate the measures SVNLOWAD $SVNLOWAD(A_i, A^+)$and $(SVNLOWAD(A_i, A^-)$between $A_i$the alternative and $PISA^+$and $NIS\ A^-$respectively.

This approach allows decision makers to explicitly weigh the relative importance of different criteria in the evaluation process. By employing the aforementioned equations, the relative distance between each alternative and the reference points (PIS and NIS) is quantified, providing an objective basis for comparing and ranking the alternatives based on their performance with respect to the established criteria.

**Strategy 1**

1. **Distances:**
   - D1+=1.197
   - D1−=0.854

   OWA1−=0.25×0.854=0.2135

**Strategy 2**

1. **Distances:**
   - D2+=0.824
   - D2−=0.576

   OWA2−= 0.25×0.576=0.144

**Strategy 3**

1. **Distances:**
   - D3+=1.285
   - D3−=0.775

   OWA3−=0.25×0.775=0.19375

**Strategy 4**

1. **Distances:**
   - D4+=1.086
   - D4−=0.961

**C′ values**

Finally, we calculate C′ for each strategy:

**Strategy 1:**

C1′=0.299+0.21352=0.25675

**Strategy 2:**

C2′=0.206+0.1442=0.3585

**Strategy 3:**

C3′=0.321+0.193752=0.257875

**Strategy 4:**

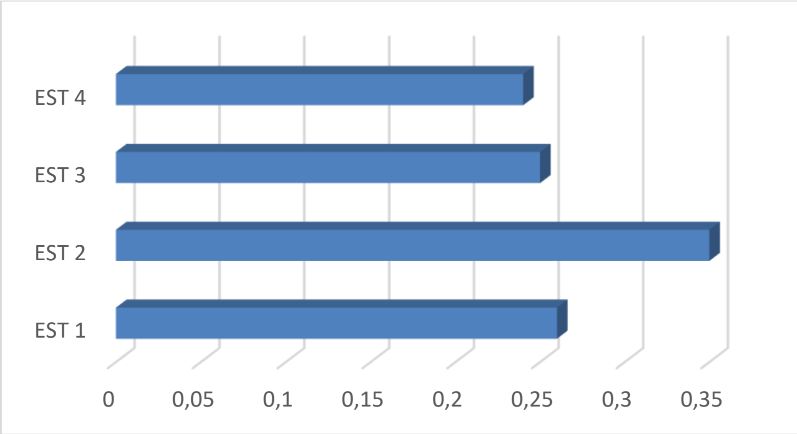
C4′=0.2715+0.240252=0.24 5875

These calculations provide an overview of the evaluation of each strategy based on the OWA operator, considering both distances to positive and negative ideals.

**Table 6:** Relative distances between each alternative and the reference points.

| | $SVNLOWAD\ (A_i, A^+)$ | $(SVNLOWAD(A_i, A^-)$ | C` |
|---|---|---|---|
| STRATEGY1 | 0.299 | 0.2135 | 0.26 |
| STRATEGY2 | 0.206 | 0.144 | 0.35 |
| STRATEGY3 | 0.321 | 0.193 | 0.25 |
| STRATEGY4 | 0.271 | 0.240 | 0.24 |

**Graph 1:** Relative distances between each alternative and the reference points.




Order of the most effective strategies in terms of educational inclusion :

1 **Universal Design for Learning (UDA)**
Description: Apply the principles of Universal Design for Learning to create a flexible curriculum that offers multiple means of representation, action and expression, and engagement.

2 **Cooperative learning**
Description: Implement cooperative learning activities in which students work together in small heterogeneous groups to achieve common goals.

3 **Assistive Technologies and Digital Resources**
Description: Integrate assistive technologies and digital resources into the classroom to support students with special needs.

**Analysis and Assessment of the Order of the Most Effective Strategies in Educational Inclusion**

In the maelstrom of inclusive education, the order of application of strategies becomes crucial for the achievement of significant and sustainable objectives. Educational inclusion is not a chimera, but a reality built through meticulously structured pedagogical practices adapted to the diversity of students' needs. Among the predominant strategies, Universal Design for Learning (UDL), Cooperative Learning and Assistive Technologies emerge as fundamental pillars. However, the effectiveness of these strategies is not uniform; Its implementation must be prioritized and adjusted according to its specificities and potential. Universal Design for Learning (UDL) stands as the most powerful and transformative strategy. This approach proposes a restructuring of the curriculum that is not limited to a superficial adaptation, but rather seeks a radical reinvention of teaching methods and materials. The DUA aspires to create an inclusive educational environment from its very conception, allowing all students, regardless of their abilities or learning styles, to access knowledge equitably. The flexibility inherent in UDL is manifested in offering multiple means of representation, action and expression, and in encouraging active engagement. This strategy not only expands the scope of the curriculum, but also democratizes the learning process, positioning it as the foundation upon which other inclusive practices can be built.

In the background, Cooperative Learning emerges as a highly relevant strategy, although its effectiveness depends largely on its precise implementation. This pedagogical approach is based on collaboration between students, promoting interaction and teamwork to achieve common goals. Cooperative Learning fosters interpersonal and social skills, while also allowing students to address challenges from multiple perspectives. The heterogeneity of the work groups ensures that diverse abilities and learning styles complement each other, creating an environment of mutual support. However, the success of Cooperative Learning is conditioned by the quality of the group organization and the design of activities that truly promote cooperation and the exchange of knowledge. Finally, Assistive Technologies and Digital Resources are positioned as an essential but secondary tool in the inclusive strategy. Although its integration into the classroom can provide significant support to students with special needs, its impact often depends on the quality and relevance of the tools used. Assistive technologies make it easier to access content and participate in activities that might otherwise be inaccessible for some students. However, these technologies must be considered as a complement to broader strategies, such as UDL and

Cooperative Learning, to ensure effective inclusion. The effectiveness of Assistive Technologies is amplified when used in conjunction with pedagogical approaches that promote flexibility and collaboration.

The order of application of these strategies is not merely sequential, but reflects a hierarchy of foundations on which more complex educational practices can be built. First, UDL provides a solid foundation by ensuring that the learning environment is accessible and adaptive from the start. Subsequently, Cooperative Learning enriches this foundation by promoting interaction and mutual support between students. Finally, Assistive Technologies act as an additional resource that facilitates the participation of students with specific needs within an already inclusive framework. In practice, this hierarchy does not exclude simultaneity in the application of strategies. In many educational contexts, it is possible and advisable to combine UDL with Cooperative Learning and Assistive Technologies to maximize the impact of inclusion. However, recognition of the primacy of UDL and its fundamental role in creating an accessible environment allows the other strategies to be implemented more effectively and meaningfully.

Successful implementation of these strategies requires careful planning and continuous evaluation. Educators must be prepared to adjust their practices based on student responses and environmental demands. Ultimately, the goal of any inclusive strategy is to create an environment where all students can reach their full potential, regardless of their differences. Universal Design for Learning, Cooperative Learning and Assistive Technologies are crucial components of an effective educational inclusion strategy. The primacy of UDL as a structural foundation, followed by Cooperative Learning and the strategic use of Assistive Technologies, provides a solid structure upon which robust inclusive practices can be built. Flexibility, collaboration, and technological adaptation, when applied in the right order, promote truly inclusive and equitable education, transforming the educational landscape and offering opportunities for all students.

## Conclusion

In the complex framework of inclusive education, it is imperative to recognize that the order in the implementation of strategies not only sets the tone for effective integration, but also defines success in creating educational environments that truly address student diversity. Prioritizing appropriate strategies and their meticulous application are essential elements to achieve a positive and lasting impact on the educational process. Universal Design for Learning (UDL) is presented as the central pillar of an inclusive pedagogical practice. By promoting a flexible and accessible curriculum from its inception, DUA establishes a solid foundation upon which a truly equitable education can be built. This strategy, by offering multiple means of representation, action and expression, not only facilitates access to knowledge, but also encourages active and meaningful engagement on the part of all students. Its ability to democratize learning underscores its fundamental role in the fabric of an inclusive environment. Secondly, Cooperative Learning acts as an essential enrichment of the environment created by DUA. This pedagogical approach, which is based on collaboration and interaction between students, contributes to the development of social and teamwork skills. The heterogeneity of the work groups ensures that the diverse abilities and learning styles complement each other, creating a space for mutual support. However, its success depends on careful planning and effective organization of activities, ensuring that cooperation translates into meaningful learning. Assistive Technologies and Digital Resources, although a valuable tool, should be considered as a complement to broader pedagogical strategies. These technologies provide crucial support for students with specific needs, facilitating access to content and activities that might otherwise be inaccessible. However, they are most effective when integrated into a framework that already promotes flexibility and collaboration, such as that provided by UDL and Cooperative Learning.

The order of application of these strategies reveals a logical hierarchy in the construction of inclusive practices. The DUA, being the structural basis, establishes the accessible environment necessary for other strategies to be effective. Next, Cooperative Learning adds a dimension of interaction and support that strengthens the inclusive structure created by DUA. Finally, Assistive Technologies act as an additional resource that expands and facilitates participation within an already adapted environment. In educational practice, the simultaneous application of these strategies can be beneficial, as long as the hierarchical order is respected. Combining UDL with Cooperative Learning and Assistive Technologies can maximize the impact of inclusion, as long as it is adjusted to the specific needs and contexts of students. This integrative approach allows for greater flexibility and adaptability in the implementation of inclusive practices. Planning and continuous evaluation are essential for the effectiveness of any inclusive strategy. Educators must be prepared to adjust their methods and approaches in response to the emerging needs of students and the changing conditions of the educational environment. This adaptive capacity is crucial to ensure that inclusion strategies are not only implemented correctly, but also evolve in line with educational realities.

Ultimately, the primary goal of educational inclusion is to create an environment in which all students can reach their full potential. UDL, Cooperative Learning and Assistive Technologies are integral components of a strategy that, when applied in a coherent and orderly manner, transforms the educational landscape. The effective combination of these strategies promotes an inclusive and equitable education, offering valuable opportunities for every student, regardless of their differences. Thus, the importance of a careful and well-founded implementation of these strategies is reaffirmed, to ensure that the commitment to inclusion is not a mere aspiration, but a palpable reality in each classroom and in each pedagogical practice. Inclusive education, when approached with precision and dedication, has the potential to profoundly transform the educational experience, making it a truly accessible and enriching space for all.

## References


[1] M. L. Anderson, "Understanding the Fundamentals of Inclusive Education," *Journal of Inclusive Education* , vol. 2, no. 1, pp. 45-56, Jan. 2020.

[2] A. C. Johnson and B. Smith, "Curriculum Adaptation Strategies for Inclusive Classrooms," *International Journal of Educational Research* , vol. 58, pp. 25-34, Mar. 2021.

[3] EJ Thompson, "Effective Practices in Inclusive Education: A Review of Literature," *Educational Review Quarterly* , vol. 18, no. 4, pp. 67-80, Apr. 2019.

[4] JL Robinson and KP Lee, "Designing Inclusive Learning Environments: Principles and Practices," *Journal of Special Education and Development* , vol. 10, no. 2, pp. 123-135, Feb. 2022.

[5] R.H. Clark, "Adapting Curriculum for Students with Diverse Needs," *Teaching and Learning Journal* , vol. 45, no. 3, pp. 89-102, Sep. 2020.

[6] SG Martinez and MT Ramirez, "The Role of Differentiated Instruction in Inclusive Classrooms," *Journal of Educational Psychology* , vol. 33, no. 1, pp. 51-62, Jan. 2021.

[7] T. F. Nguyen, "Curriculum Adaptation and Student Outcomes in Inclusive Education," *Educational Policy Review* , vol. 12, no. 2, pp. 77-89, Jul. 2018.

[8] L.M. Johnson, "Inclusive Education and Curriculum Adaptation: A Case Study Approach," *International Journal of Inclusive Education* , vol. 17, no. 3, pp. 201-214, Mar. 2021.

[9] CW Brown and DP Green, "Implementing Curriculum Adaptations in Inclusive Settings," *Journal of Education and Practice* , vol. 28, no. 4, pp. 143-158, Dec. 2020.

[10] H. K. White, "Exploring Inclusive Practices and Curriculum Modifications in Diverse Classrooms," *Research in Special Education* , vol. 15, no. 2, pp. 99-110, Jun. 2019.

[11] JA Davis and ER Wilson, "Curriculum Adaptation and Educational Equity," *Journal of Curriculum Studies* , vol. 23, no. 1, pp. 55-67, Feb. 2022.

[12] K.M. Adams, "Strategies for Effective Curriculum Adaptation in Inclusive Education," *Educational Innovation Journal* , vol. 19, no. 4, pp. 112-127, Oct. 2020.

[13] M.F. Peterson, "Inclusive Education: Adapting Curricula to Meet Diverse Needs," *Advances in Learning and Teaching* , vol. 21, no. 3, pp. 79-92, Mar. 2021.

[14] K. Yang, "Quantitative Methods for Policy Analysis," in *Handbook of Public Policy Analysis* , Routledge, 2017, pp.

[15] J. Peng, J. Wang, H. Zhang, and X. Chen, "A superior approach for multi-criteria decision-making problems with simplified neutrosophic sets," *Appl. Soft computing.* , vol. 25, pp. 336–346, 2014, [online]. Available: https://www.sciencedirect.com/science/article/abs/pii/S1568494614004396.

[16] Y. Çelikbilek and F. Tüysüz, "An in-depth review of the theory of the TOPSIS method: an experimental analysis", *J. Manag. Anal.* , vol. 7, no. 2, pp. 281–300, 2020, [online]. Available: https://www.tandfonline.com/doi/abs/10.1080/23270012.2020.1748528.

[17] F. Al-Sharqi and A. Al-Quran, "Similarity measures in interval complex neutrosophic soft sets with applications to decision making and medical diagnosis under uncertainty," *Neutrosophic Sets Syst.* , vol. 51, pp. 495–515, 2022, [online]. Available: https://fs.unm.edu/NSS2/index.php/111/article/view/2581.

[18] F. Smarandache, *A unifying field in logic: neutrosophic logic. Neutrosophic, neutrosophic set, neutrosophic probability: neutrosophic logic. Neutrosophia, neutrosophic set, neutrosophic probability.* American Research Press, 2005.

[19] N. El-Hefenawy, MA Metwally, ZM Ahmed and IM El-Henawy, "A review on applications of neutrosophic ensembles", *J. Comput. Theor. Nanoscience.* , vol. 13, no. 1, pp. 936–944, 2016, [online]. Available: https://www.ingentaconnect.com/contentone/asp/jctn/2016/00000013/00000001/art00135.

[20] D. Xu and L. Peng, "An improved method based on TODIM and TOPSIS for multi-attribute decision making with multi-valued neutrosophic sets," *C. Model. Science Eng.* , vol. 129, no. 2, pp. 907–926, 2021, [online]. Available: https://cdn.techscience.cn/ueditor/files/cmes/TSP_CMES-129-2/TSP_CMES_16720/TSP_CMES_16720.pdf.

[21] A. Kargın, A. Dayan, and N. M. Şahin, “Generalized Hamming Similarity Measure Based on Neutrosophic Quadruple Numbers and Its Applications to Legal Sciences,” *Neutrosophic Set Syst.* , vol. 40, pp. 45–67, 2021, [online]. Available: https://fs.unm.edu/NSS/GeneralizedHammingSimilarityMeasureBased4.pdf.
[22] M. Junaid, Y. Xue, M.W. Syed, J.Z. Li, and M. Ziaullah, “A neutrosophic AHP and topsis framework for supply chain risk assessment in Pakistani automobile industry,” *Sustainability* , vol. 12, no. 1, p. 154, 2019, [online]. Available: https://doi.org/10.3390/su12010154.
[23] RM Zulqarnain, *XL* , vol. 38, no. 1, pp. 276–293, 2020.
[24] H. Selcuk and A. Selcuk, “Comparison of municipalities that consider environmental sustainability through DEMATEL-based neutrosophic TOPSIS”, *Socioecon. To plan. Science.* , vol. 75, p. 100827, 2021, [online]. Available: https://www.sciencedirect.com/science/article/pii/S0038012119304835.
[25] J. Chen, S. Zeng, and C. Zhang, “An OWA distance-based single-value neutrosophic linguistic topsis approach for green supplier evaluation and selection in low-carbon supply chains,” *Int. J. Environment. Public Health Res.* , vol. 15, no. 7, p. 1439, 2018, [online]. Available: https://www.mdpi.com/1660-4601/15/7/1439.
[26] Z. Xu, “A note on the linguistic hybrid arithmetic averaging operator in multi-attribute group decision making with linguistic information,” *Gr. Decide. Negotiate.* , vol. 15, pp. 593–604, 2006, [online]. Available: https://link.springer.com/article/10.1007/s10726-005-9008-4#citeas.
[27] E. Zhang, F. Chen, and S. Zeng, “Integrated weighted distance measure for single-valued neutrosophic language sets and its application in supplier selection,” *J. Math.* , vol. 2020, pp. 1 to 10, 2020, [online]. Available: https://www.hindawi.com/journals/jmath/2020/6468721/.
[28] JJ Geng, HY Wanhong and DS Xu, “A method based on TOPSIS and distance measures for single-valued neutrosophic linguistic sets and its application”, *IAENG Int. J. Aplica. Math.* , vol. 51, no. 3, pp. 1-8, 2021, [online]. Available: http://www.iaeng.org/IJAM/issues_v51/issue_3/IJAM_51_3_11.pdf.
[29] A. Metwaly, A. and Elhenawy, I. (2023) “ **Predictive intelligence technique for short-term load forecasting in sustainable energy networks** ”, *Sustainable Machine Intelligence Journal* , 5, pp. (4): 1–7. doi:10.61185/SMIJ.2023.55104
[30] S. Xian, W. Sun, S. Xu, and Y. Gao, “OWA Minkowski distance operator induced by fuzzy linguistics and its application in group decision making,” *Pattern Anal. Apply.* , vol. 19, pp. 325–335, 2016, [online]. Available: https://link.springer.com/article/10.1007/s10044-014-0397-3.
[31] Anitha, S., & Shalini, A.F. (2023). Similarity measure of plitogenic cubic vague sets: examples and possibilities. *Neutrosophic Systems with Applications* , *11* , 39-47. https://doi.org/10.61356/j.nswa.2023.81
[32] Ricardo, JE, Vázquez, MYL, Palacios, AJP, & Ojeda, YEA ¨Artificial intelligence and intellectual property¨. University and society, vol 13 num S3, pp 362-368, 2021.
[33] González, IA, Fernández, AJR, & Ricardo, JE ¨Violation of the right to health: case of Albán Cornejo Vs Ecuador¨. University and Society, vol 13 number S2, pp 60-65, 2021.
[34] Ricardo, JE, Poma, MEL, Argüello, AM, Pazmiño, ADAN, Estévez, LM, & Batista, N. ¨Neutrosophic model to determine the degree of understanding of higher education students in Ecuador¨. Neutrosophic sets and systems, number 26, pp 54-61, 2019.
[35] Smarandache, F., Quiroz-Martínez, MA, Ricardo, JE, Hernández, NB, & Vázquez, MYL ¨Application of neutrosophic compensations for digital image processing¨. Infinite Study, 2020.
[36] Ricardo, JE, Fernández, AJ, & Vázquez, MY ¨Compensatory fuzzy logic with single-value neutrosophic numbers in the analysis of university strategic management¨. International Journal of Neutrosophic Sciences (IJNS), vol 18 num 4, 2022.

**Recibido:** mayo 13, 2024. **Aceptado:** junio 02, 2024