



Sentiment Analysis and NeutroAlgebra to Evaluate Organizational Strategies and Performance Levels of Basic Education Teachers

Erick Félix Quesquén Alarcón¹, Hermenegildo Chaccara Huachaca², Luz Marina Sito Justiniano³, Yessika Madelaine Abarca Arias⁴, Mary Liz Mendoza Hidalgo⁵, and Dante Manuel Macazana Fernández⁶

¹National University of San Marcos. Peru; equescuena@unmsm.edu.pe

²Micaela Bastidas National University of Apurímac. Peru; hchaccara@unamba.edu.pe

³Enrique Guzmán y Valle National University of Education. Peru; lsito@une.edu.pe

⁴National University of San Agustín de Arequipa. Peru; yabarca@unsa.edu.pe

⁵National University Federico Villarreal, Peru; mmendozam@unfv.edu.pe

⁶National University of San Marcos. Peru; dmacazanaf_af@unmsm.edu.pe

Abstract. The study addresses the problem of evaluating the organizational strategies and performance levels of basic education teachers through an innovative approach in sentiment analysis. In the current context, there is a growing need for accurate and reliable methods to measure the impact of organizational strategies on educational performance, especially given the importance of educational quality for social development. The existing literature has shown limitations in integrating methods that can handle the complexity and subjectivity of teachers' emotional and attitudinal perceptions, creating a gap that this study aims to fill. Using the neutrosophic sentiment analysis method based on neutroalgebra, the study offers a new perspective to evaluate how organizational strategies affect teacher performance, thus addressing the limitations of traditional approaches. The results indicate that the neutrosophic method provides a more complete and nuanced assessment of teachers' feelings and the impact of organizational strategies on them. This approach reveals patterns of performance that were not evident with conventional methods. The main contribution of the study lies in its ability to capture the emotional and organizational complexity in the evaluation of teaching performance, thus offering theoretical and practical tools to improve educational management. Additionally, the study provides practical recommendations for adjusting organizational strategies based on teachers' perceptions and feelings, which can lead to significant improvement in the educational environment and performance outcomes.

Keywords: Organizational Strategies, Educational Performance, Neutroalgebra, Prospector, Sentiment Analysis.

1. Introduction

Sentiment analysis in the context of organizational strategies and teaching performance in basic education is a topic of increasing relevance. In a constantly changing educational environment, understanding how organizational strategies impact teacher performance and how teachers, in turn, perceive and react to these strategies is crucial to improving educational quality. Research in this area is significant because it offers tools to adapt and optimize educational policies, based on the perception and sentiment of key actors [1]. This research, focused on the neutrosophic sentiment analysis method based on neutroalgebra, seeks to fill an important gap in the literature by providing an advanced methodology to evaluate these dynamics.

Historically, the evaluation of teaching performance has moved from purely qualitative and descriptive methods to more quantitative and structured approaches. Since early attempts to measure performance through direct observations and subjective evaluations, the field has evolved toward techniques that include statistical analyzes and standardized surveys. However, despite these advances, current methods still do not fully capture teachers' emotional complexity and its impact on performance. Developments in sentiment analysis and organizational evaluation techniques have been important, but

the integration of these into a neutrosophic framework is still incipient [2]. The main problem that this study addresses is the lack of a comprehensive methodology that combines sentiment analysis, feelings with the evaluation of organizational strategies in the educational context. The central research question is: how can the neutrosophic sentiment analysis method based on neutroalgebra provide a more complete and accurate assessment of organizational strategies and teaching performance? This issue is crucial given that most existing methods fail to adequately capture the intersection between teachers' emotions and the effectiveness of organizational strategies [3]. The purpose of this study is to develop and validate a neutrosophic sentiment analysis method that uses neutroalgebra to accurately assess how organizational strategies affect teachers in basic education. The first objective is to design a tool that effectively integrates sentiment analysis with strategy evaluation, allowing a deeper understanding of the relationship between these variables. The second objective is to apply this method in a real context to obtain detailed insights about the impact of organizational strategies on teaching performance [4]. In addition to these objectives, the study seeks to provide practical recommendations for the improvement of organizational strategies based on the results obtained. By providing an advanced analytical tool, it is intended to offer education policy makers a more precise and nuanced approach to decision making. The findings of this research could have significant implications for the way organizational strategies are designed and implemented in the education sector [5]. In summary, the proposed approach seeks to fill an important gap in the evaluation of organizational strategies through a method that captures both emotions and the impact of policies on teacher performance. This innovative approach has the potential to transform how the dynamics between organizational strategies and educational performance are understood and addressed. The article will be structured around the detailed explanation of the proposed neutrosophic methodology, its practical application and an analysis of the results obtained [6]. The research hopes to contribute to the field with a new analytical model that can be adapted and used in various educational contexts to improve the effectiveness of organizational strategies and, ultimately, the quality of education.

2. Preliminaries

2.1. Sentiment analysis

Sentiment analysis is the application of natural language processing, text analysis, and computational linguistics to discern and extract subjective information from sources [7]. In the realm of text mining, Sentiment Analysis is focused on the extensive classification of information polarity.

Sentiment analysis encompasses three primary categories: lexical affinity, statistical methods, and concept-level techniques. Nonetheless, we cannot evade the intricacies associated with quantifying the emotions of an individual or a collective, owing to the inherent subjectivity of the issue. This is due to the transient nature of emotive states, which may be represented in one manner in a survey, yet can subsequently shift to a different state moments later.

Experts concur that a neutral opinion is an indispensable component of the measurement scale, as individuals may be unable to distinguish their sentiments as either negative or positive, or their feelings may reside in a neutral state that is neither positive nor negative. The relevance of Neutrosophy lies in its incorporation of neutrality with positive and negative elements. This can also be beneficial for analyzing the connotation of terms inside the text.

2.2 Neutral algebra generated by the join function in Prospector

For a natural number $n > 0$, NeutroGroup is specified from the Prospector combinator function . Prospector is the well-known expert system utilized to model mining problems [7,8]. The set NeutroGroup consists of all integers between $-n$ and n plus the symbolic element I to symbolize indeterminacy. This is $NG_5 = \{-5, -4, -3, -2, -1, 0, 1, 2, 3, 4, 5, I\}$ and \oplus_5 is used. This is expressed according to the following Cayley table:

Table 1. Cayley table corresponding to \oplus_5 . Source: [8].

\oplus_5	-5	-4	-3	-2	-1	0	Yo	1	2	3	4	5
-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	I
-4	-5	-5	-5	-5	-4	-4	-4	-4	-3	-2	0	5
-3	-5	-5	-4	-4	-4	-3	-3	-2	-1	0	2	5
-2	-5	-5	-4	-3	-3	-2	-2	-1	0	1	3	5
-1	-5	-4	-4	-3	-2	-1	-1	0	1	2	4	5
0	-5	-4	-3	-2	-1	0	I	1	2	3	4	5
I	-5	-4	-3	-2	-1	I	I	I	I	I	I	I
1	-5	-4	-2	-1	0	1	I	2	3	4	4	5
2	-5	-3	-1	0	1	2	I	3	3	4	5	5
3	-5	-2	0	1	2	3	I	4	4	4	5	5
4	-5	0	2	3	4	4	I	4	5	5	5	5
5	Yo	5	5	5	5	5	Yo	5	5	5	5	5

\oplus_5 fulfills the properties of commutativity and associativity and has 0 as a null element. Furthermore, it satisfies each one of the following properties :

- If $x, y < 0$ then $x \oplus_5 y \leq \min(x, y)$,
- If $x, y > 0$ then $x \oplus_5 y \geq \max(x, y)$,
- If $x < 0$ and $y > 0$ or if $x > 0$ and $y < 0$, then we have $\min(x, y) \leq x \oplus_5 y \leq \max(x, y)$.
- $\forall x \in G, x \oplus_5 0 = x$.
- $(-5) \oplus_5 5 = 5 \oplus_5 (-5) = I$.

The sentiment analysis technique theory analyzes opinions and perceptions based on levels of positivity, negativity, and indeterminacy. This facilitates the capture of positive, negative, neutral, and ambiguous emotions, yielding a precise evaluation and enhancing comprehension of how these elements are viewed within businesses.

The proposed method is applicable to brief informal texts, similar to the aforementioned strategy. A collection of words must be identified and categorized as positive, negative, or neutral, with a strength value assessed on a scale from -5 to 5 or deemed undetermined.

The evaluation of the indeterminate form occurs due to our inability to ascertain the individual's perspective on the subject. This may occur due to the language being incomprehensible or the intended meaning being ambiguous.

Another alternative is that within the same sentence, each of the aforementioned variables is expressed with a maximum positive evaluation (+5) and a maximum negative evaluation (-5), resulting in a contradiction and therefore deemed indeterminate. I.

It is important to note that the function underlying the PROSPECT expert system signifies the extent of evidence the expert possesses for a certain issue. When this evidence is consolidated across two features exhibiting the highest degree of opposition, a contradiction arises. This is why we discuss the benefits of this strategy utilizing NeutroOperation, where the indeterminacy may arise from two

sources. Some aspects we have used are taken from the sentiment strength detection algorithm SentiStrength [9].

- The terminology associated with each preceding variable is categorized as Positive, Negative, or Neutral within a list composed of linguistic values. Each of these phrases is connected with a value ranging from -5 to 5, reflecting its degree of strength and its positive or negative connotation. The term "like" is enhanced with a stronger positive connotation in the phrase "I like it a lot," yet it is also increased with a more negative connotation in the expression "I don't like it very much."

What concerns is that for the word "a lot" or "a lot" that modifies one of the positive or negative classifier words, is used $x \oplus_5 x$, and for "too much" $x \oplus_5 x \oplus_5 x$, where x is the value that is connected with the word. For example, $x > 0$ results in "very" with an even more positive value. On the other hand, when $x < 0$, the result is more negative.

Additionally, the modification of "quite" is converted to $[sig(x)\sqrt{|x|}]$ [10].

- They consider words that invert the meaning of what was said. In this case the sign is changed. For example, "I like" with a value of $x = 3$, when it comes to "I don't like" it is calculated as $x = -3$, both have the same strength, but with opposite meanings.
- In this algorithm, complex scenarios using exclamation or question marks are disregarded, as the objective is to assess the coherence of the organization members' or clients' comments about each of the twelve ethical aspects previously mentioned. Another aspect that is considered in the proposed algorithm taken from the precedent is the evaluation of emoticons.
- Spell checking is also applied.

The next step is the evaluation of a short informal text written by one person. To do this, natural language processing is carried out where words are searched that express feelings or opinions about each of the twelve aforementioned aspects. Let us denote these aspects as: $V = \{v_1, v_2, \dots, v_{12}\}$.

Then, within the text processing, the words indicating to each of these variables are detected. These words are labeled with a value from -5 to 5 or I . Let us denote this as follows, for the i^{th} variable, the set X_i of evaluations of words that appear in the text [11,12]:

$v_i \rightarrow X_i = \{x_{i1}, x_{i2}, \dots, x_{im_i}\}$, where x_{ij} is the set of elements between -5 and 5 or I , used to qualify words that refer to the i^{th} variable.

It is important to note that assessing each word individually might be intricate. For instance, the presence of modifiers like "very" alters the value of the modified term. Additionally, when spelling problems render certain evaluations illegible, it is imperative to utilize the value I . The final value associated with each v_i is:

$$x_{total,i} = x_{i1} \oplus_5 x_{i2} \oplus_5 \dots \oplus_5 x_{im_i} \tag{1}$$

We should remember that deriving a collective ethical value for all variables is impractical, as individual values provide a clearer understanding of personal opinions or sentiments.

If we have a group of people whose opinion is analyzed. Let's call this set of people by $P = \{p_1, p_2, \dots, p_l\}$, so that the values are taken into account, $x_{total,i,j}$ it is the total value of the i^{th} ethics variable in the organization, according to the j^{th} person. It is calculated [13]:

$$\bar{x}_{total,i} = \frac{\sum_{j=1}^l x_{total,i,j}}{l} \tag{2}$$

That is, the arithmetic mean of each of the variables.

3. Case Study.

This study applies the **method of neutrosophic sentiment analysis** to evaluate the organizational strategies and performance levels of basic education teachers. A series of variables are used that reflect different organizational and teaching performance aspects. These variables are evaluated based on the opinions and perceptions of teachers, classified in terms of positivity, negativity and indeterminacy. Evaluations are assigned values ranging from -5 to 5, or are classified as indeterminate (I) when the opinion is unclear.

Organizational Aspects Evaluated:

1. **Internal Communication**
2. **Support for Innovation**
3. **Knowledge Management**
4. **Resources and Equipment**

Evaluated Performance Levels:

1. **Class Preparation**
2. **Teaching Methodology**
3. **Relationship with Students**
4. **Student Evaluation**

2. Data Collection

A survey was conducted with a sample of 20 teachers, who evaluated each of the aforementioned variables. The responses were processed using the neutrosophia methodology to determine the sentiment values in each variable.

Evaluation Data Collected

The data is presented in the following table, where each teacher has evaluated the variables with a numerical value corresponding to the feeling associated with each aspect.

Internal Communication:

Table 2. Evaluation of Internal Communication.

Teaching	Evaluation 1	Value 1	Evaluation 2	Value 2	Total
1	Clear	+4	Efficient	+3	+7
2	Confused	-4	Deficient	-3	-7

Teaching	Evaluation 1	Value 1	Evaluation 2	Value 2	Total
3	Clear	+4	Neutral	0	+4
4	Efficient	+3	Clear	+4	+7
5	Deficient	-3	Confused	-4	-7
6	Moderate	+3	Efficient	+3	+6
7	Clear	+4	Low	-4	0
8	Efficient	+3	Confused	-4	-1
9	Clear	+4	Clear	+4	+8
10	Confused	-4	Deficient	-3	-7
11	Clear	+4	Moderate	+3	+7
12	Deficient	-3	Efficient	+3	0
13	Efficient	+3	Clear	+4	+7
14	Confused	-4	Deficient	-3	-7
15	Clear	+4	Efficient	+3	+7
16	Moderate	+3	Deficient	-3	0
17	Clear	+4	Clear	+4	+8
18	Deficient	-3	Confused	-4	-7
19	Efficient	+3	Efficient	+3	+6
20	Clear	+4	Clear	+4	+8

Support for Innovation:

Table 3. Evaluation of Support for Innovation

Teaching	Evaluation 1	Value 1	Evaluation 2	Value 2	Total
1	Strong	+5	Moderate	+3	+8
2	Low	-4	Null	-5	-9
3	Moderate	+3	Strong	+5	+8
4	Strong	+5	Low	-4	+1
5	Null	-5	Moderate	+3	-2
6	Strong	+5	Moderate	+3	+8
7	Low	-4	Null	-5	-9
8	Moderate	+3	Strong	+5	+8
9	Strong	+5	Low	-4	+1
10	Null	-5	Moderate	+3	-2
11	Moderate	+3	Strong	+5	+8
12	Strong	+5	Low	-4	+1
13	Low	-4	Null	-5	-9
14	Moderate	+3	Strong	+5	+8
15	Strong	+5	Moderate	+3	+8
16	Low	-4	Null	-5	-9
17	Moderate	+3	Strong	+5	+8
18	Strong	+5	Low	-4	+1
19	Null	-5	Moderate	+3	-2
20	Strong	+5	Moderate	+3	+8

Class Preparation:

Table 4. Evaluation of Class Preparation:

Teaching	Evaluation 1	Value 1	Evaluation 2	Value 2	Total
1	Excellent	+5	Good	+4	+9
2	Regular	0	Insufficient	-3	-3
3	Good	+4	Excellent	+5	+9
4	Insufficient	-3	Regular	0	-3
5	Good	+4	Excellent	+5	+9
6	Regular	0	Insufficient	-3	-3
7	Excellent	+5	Good	+4	+9
8	Insufficient	-3	Regular	0	-3
9	Good	+4	Excellent	+5	+9
10	Regular	0	Insufficient	-3	-3
11	Excellent	+5	Good	+4	+9
12	Insufficient	-3	Regular	0	-3
13	Good	+4	Excellent	+5	+9
14	Regular	0	Insufficient	-3	-3
15	Excellent	+5	Good	+4	+9
16	Insufficient	-3	Regular	0	-3
17	Good	+4	Excellent	+5	+9
18	Regular	0	Insufficient	-3	-3
19	Excellent	+5	Good	+4	+9
20	Insufficient	-3	Regular	0	-3

Teaching Methodology:

Table 5. Evaluation of Teaching Methodology .

Teaching	Evaluation 1	Value 1	Evaluation 2	Value 2	Total
1	Innovative	+4	Efficient	+3	+7
2	Traditional	-3	Inefficient	-4	-7
3	Efficient	+3	Innovative	+4	+7
4	Inefficient	-4	Traditional	-3	-7
5	Efficient	+3	Innovative	+4	+7
6	Traditional	-3	Inefficient	-4	-7
7	Innovative	+4	Efficient	+3	+7
8	Inefficient	-4	Traditional	-3	-7
9	Efficient	+3	Innovative	+4	+7
10	Traditional	-3	Inefficient	-4	-7
11	Innovative	+4	Efficient	+3	+7
12	Inefficient	-4	Traditional	-3	-7
13	Efficient	+3	Innovative	+4	+7
14	Traditional	-3	Inefficient	-4	-7
15	Innovative	+4	Efficient	+3	+7
16	Inefficient	-4	Traditional	-3	-7
17	Efficient	+3	Innovative	+4	+7
18	Traditional	-3	Inefficient	-4	-7
19	Innovative	+4	Efficient	+3	+7
20	Inefficient	-4	Traditional	-3	-7

3. Analysis of the Results

For each variable evaluated, the total value is calculated using the neutrosophic aggregation operation. This operation is performed by adding the values of each evaluation.

$$x_{total,i} = x_{i1} \oplus_5 x_{i2} \oplus_5 \dots \oplus_5 x_{im_i} \quad (1)$$

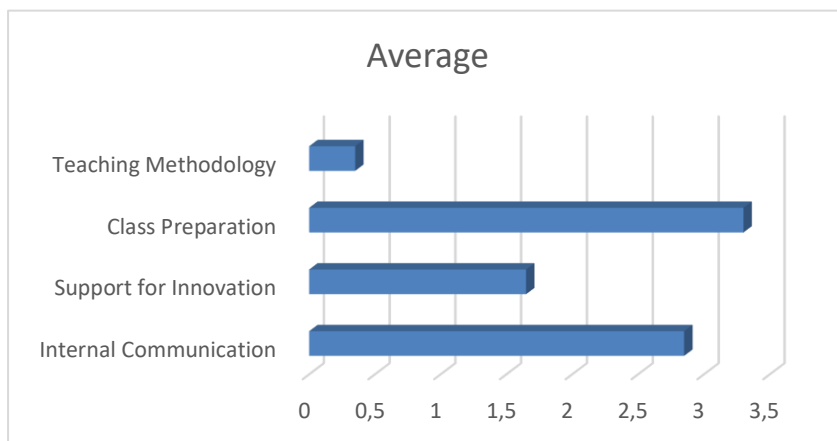
It is calculated:

$$\bar{x}_{total,i} = \frac{\sum_{j=1}^l x_{total,i,j}}{l} \quad (2)$$

This value represents the average evaluation of internal communication between teachers.

Table 6: Averages of Evaluations by Variable.

Variable	Average
Internal Communication	2.85
Support for Innovation	1.65
Class Preparation	3.3
Teaching Methodology	0.35



Graph 1: Averages of Evaluations by Variable.

Internal Communication and **Class Preparation** positively, with averages higher than 2.5. However, challenges are observed in **Support for Innovation** and **Teaching Methodology**, which present values close to 1 or lower, which indicates a more neutral or even negative perception in these aspects. The neutrosophic analysis has made it possible to identify key areas for improvement in organizational strategies and levels of teaching performance, providing a clear and nuanced view of teacher perceptions in these areas. The results of the study reveal that teachers positively value **Internal Communication** and **Class Preparation**, with averages of 2.85 and 3.3 respectively. However, areas of improvement were identified in **Support for Innovation** and **Teaching Methodology**, which obtained averages of 1.65 and 0.35, reflecting a more neutral or negative perception. These findings suggest that, although teachers consider **Internal Communication** and **Class Preparation** as satisfactory aspects within the educational environment, significant challenges persist in the implementation of pedagogical innovations and teaching methodologies. The high valuation of **Internal Communication** can be explained by an organizational environment that facilitates the exchange of information and coordination between staff members. On the other hand, the low score in **Support for Innovation** could indicate a resistance

to change or the lack of resources necessary for the implementation of new ideas. **Teaching Methodology** was the variable with the lowest score, which could reflect a reliance on traditional practices and limited adoption of modern pedagogical approaches, possibly due to a lack of ongoing training or incentives to innovate in teaching.

When comparing these results with previous studies, a similar trend is observed in the assessment of **Internal Communication** as a key component in teacher satisfaction, in line with research that highlights the importance of effective communication for the functioning of educational organizations. However, the low valuation of **Innovation Support** contrasts with studies that indicate a growing interest in the adoption of educational technologies, which could indicate a gap between intention and implementation in specific contexts. The **Teaching Methodology** obtained particularly low results, coinciding with research that highlights the need to reform traditional pedagogical practices in basic education. This study has several limitations that should be considered when interpreting the results. First, the sample used is relatively small and specific, which could limit the generalizability of the findings to other educational contexts. Furthermore, the subjectivity inherent in teachers' responses could have influenced the evaluations, especially in aspects related to innovation and teaching methodology. Finally, the neutrosophic approach, although effective in managing uncertainty, may not fully capture the complexity of teacher perceptions in all cases.

The results of this study highlight the need to continue exploring mechanisms to promote educational innovation and methodological updating among teachers. Future research could focus on identifying specific barriers that prevent the adoption of new teaching methodologies and developing more effective training programs. Furthermore, the implementation of larger scale studies is suggested to validate these findings in different contexts and improve the understanding of how to improve internal communication and support for innovation within educational institutions. A result that deserves special attention is the low rating of the **Teaching Methodology**, which was not only the lowest score, but also showed a marked divergence with respect to other variables. This anomaly could be related to factors not evaluated in this study, such as teachers' perception of the relevance of continuous training or the pressure to comply with established curricula. However, the lack of a definitive explanation for this result suggests the need for additional research that addresses this phenomenon in greater depth. This discussion provides a comprehensive framework for understanding the study findings, while highlighting key areas for future research and improvements in educational practice.

5. Conclusion

The present study introduces a neutrosophic model of sentiment analysis applied to the evaluation of twelve ethical variables in an educational environment. Using the NeutroGroup generated by an offuninorm, it was possible to accurately analyze the perception of teachers on key aspects such as Internal Communication, Class Preparation, Support for Innovation and Teaching Methodology. The results reflect a positive perception towards Internal Communication and Class Preparation, with averages higher than 2.5, while significant areas of improvement were identified in Support for Innovation and Teaching Methodology, with values close to 1 or lower. These findings highlight the usefulness of the model in identifying and addressing indeterminacy in teachers' perceptions, allowing for a more nuanced understanding of their opinions and attitudes. From a practical perspective, the developed model not only facilitates the identification of strengths and weaknesses in organizational strategies, but also highlights the need to promote pedagogical innovation and methodological updating in the educational field. The low assessment of Support for Innovation and Teaching Methodology suggests barriers in the adoption of new practices, possibly derived from the lack of training or resources. These results invite future research to further explore these challenges, proposing more effective training programs and additional studies to validate and generalize the findings in different educational contexts. This model represents a significant contribution to ethical and organizational analysis, offering new

ways to improve performance and satisfaction in educational environments.

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