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Studying health and inclusive education: sentiment analysis using neutrosophy as a research tool

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Abstract: The coronavirus (COVID-19), from its propagation and virulence, has constituted the second global pandemic of the XXI century, claiming humanity, lives worldwide, in high scales, being Ecuador one of the affected countries and Guayas Canton with the highest morbidity and mortality, reasons why it has generated a social distancing as preventive measures. Present work aimed at the survey and intervention of health and educational problems manifested by parents and students with disability in regular education in District 09D17 of Milagro. For the first time, neutrosophic sets have been used to analyze interviews as a qualitative research tool. This paper is the first step of research that points out the uncertainties arising in qualitative data analysis. Among its main achievements are the change of behavior of the intervened families towards healthier lifestyles in the area of nutrition, psycho-pedagogical and social care, preparation for the life of these students, as well as the level of organization of students and researchers, teamwork, the use of communicational and digital tools to reach an improvement in the quality of life of these children.

Keywords: Transtheoretical model, Health education, Virtual education, Families of students with disability, adaptive behavior. Neutrosophy, SVN, sentiment analysis, neutrosophic research method.

1. Introduction

At a global level, the current society is going through a health crisis known to all: COVID-19, in which health systems face an arduous task as a result of the high morbimortality resulting from the pandemic, therefore, a group of actions are taken in most countries, imposing restrictions in general that contribute to reducing the transmission of the virus, and among these, it begins to experiment in the educational field a different social learning modality, being virtual education the hope of improving quality of life of the population[1].

In this current context, parents of families and students with Special Educational Needs (SEN in Spanish) [2]associated or not to disability (Intellectual and developmental, Physical, Sensory, Mental, constitute a population group of high vulnerability, from chronic diseases generated first by the ageing of parents, along with unfavorable lifestyles and then those acquired in their children as part of the manifest disabilities, which reveal difficulties in the quality of health.

In addition to this analysis, difficulties in accessing information are observed, which causes digital exclusion[3] in the educational field, the lack of knowledge of support systems for the education of

their children, family isolation, chaos, translated into hopelessness, in this new role that they must assume from their homes towards their children and access to health services. In this sense, the educational inclusion of these students in virtual mode becomes a severe problem for the family and the educational institution because they try to support them from their place. However, it requires a personalized approach, which does not consistently achieve its purpose, as this feeling is reflected with high prevalence in social networks; on the other hand, it was seen in statistics of the Milagros canton the increase of health problems in this population mentioned above.

With these elements, the group of researchers and students of the Special Education career decide to conduct a study that leads to improving the health and quality of inclusive education of these students, in conditions of isolation of the population, through training to parents, to create practical attitudes and try to raise awareness in this vulnerable group the incorporation of healthier lifestyles that includes: hygiene, nutrition, sports and creative activities, relating social, environmental and economic factors by using health education, through the Transtheoretical model and based on neutrosophic research method.

2. Neutrosophy in sentiment analysis basic concepts

Neutrosophy is a mathematical theory developed by Romanian Scholar Florentin Smarandache to deal with indetermination[4]. It has been the base for developing new methods to deal with indeterminate and inconsistent information as neutrosophic sets neutrosophic logic and, especially, in decision-making problems [5]. The truth value in the neutrosophic set is as follow[6]:

Let be $\boldsymbol{N} = \{(\boldsymbol{T}, \boldsymbol{I}, \boldsymbol{F}): \boldsymbol{T}, \boldsymbol{I}, \boldsymbol{F} \subseteq [\boldsymbol{0}, \boldsymbol{1}]\}\boldsymbol{n}$, be a neutrosophic evaluation of a mapping of a group of formulas propositional to $\boldsymbol{N}$, and for each sentence $\boldsymbol{p}$:

$$\boldsymbol{v}(\boldsymbol{p}) = (\boldsymbol{T}, \boldsymbol{I}, \boldsymbol{F}) \quad (1)$$

To facilitate the practical application in real-world problems[7], the use of Single-Value neutrosophic Sets (SVNS) was proposed, through which it is likely to use linguistic terms to obtain greater interpretability of the results[8].

Let X be a universe of discourse, an SVNS A over X has the following form[9]:

$$\boldsymbol{A} = \{\langle \boldsymbol{x}, \boldsymbol{u_a}(\boldsymbol{x}), \boldsymbol{r_a}(\boldsymbol{x}), \boldsymbol{v_a}(\boldsymbol{x})\rangle : \boldsymbol{x} \in \boldsymbol{X}\} \quad (2)$$

Where

$$\boldsymbol{u_a}(\boldsymbol{x}): \boldsymbol{X} \to [\boldsymbol{0}, \boldsymbol{1}], \boldsymbol{r_a}(\boldsymbol{x}): \boldsymbol{X} \to [\boldsymbol{0}, \boldsymbol{1}] \; \boldsymbol{y} \; \boldsymbol{v_a}(\boldsymbol{x}): \boldsymbol{X} \to [\boldsymbol{0}, \boldsymbol{1}]$$

with
$$\boldsymbol{0} \leq \boldsymbol{u_a}(\boldsymbol{x}), \boldsymbol{r_a}(\boldsymbol{x}), \boldsymbol{v_a}(\boldsymbol{x}) \leq \boldsymbol{3}, \forall \; \boldsymbol{x} \in \boldsymbol{X}$$

The intervals $\boldsymbol{u_a}(\boldsymbol{x}), \boldsymbol{r_a}(\boldsymbol{x})$ **y** $\boldsymbol{v_a}(\boldsymbol{x})$ denote the memberships related to true, indeterminate and false from x in A, respectively[10]. For convenience reasons, a Single Value Neutrosophic Number (SVN) is expressed as A = (a, b, c), where a, b, c ∈ [0.1] and 0 ≤ a + b + c ≤ 3.

Let A = (a, b, c) be a single valued neutrosophic number, a score function S related to a single valued neutrosophic value, based on the truth-membership degree, indeterminacy-membership degree and falsity membership degree is defined by[11]:

$$s(V_i) = 2 + T_i - F_i - I_i \quad (4)$$

The score function for single-valued neutrosophic sets is proposed to make the distinction between numbers.

In social sciences, a primary research methodology such as one-on-one interviews constitutes a widely used technique to derive meaningful insights and draw broad conclusions[12]. Once transcribed, these interviews help in providing qualitative analyses. However, such analyses are subjective and draw heavily from the unconscious biases of the authors or researchers. That apart, the learning from every new interview diminishes at a high rate and is not an efficient use of the researchers' valuable time. Neutrosophy, which features the concept of indeterminacy, has not been widely used in sentiment analysis of interviews. Neutrosophic sets are used for sentiment analysis of interviews as a qualitative research tool[13]. This study is the first step of research that points out the uncertainties in the discursive analysis[14].

2. Materials and Methods (proposed work with more details)

The population was represented by 197 families of students with Special Educational Needs to be Associated with disability of District 09D17 Milagro, according to a database provided by the Inclusion Support Unit (UDAI), of which 150 families were surveyed, as part of the Hermeneutic interpretative analysis in the 1st stage known as Structuring and coding of the research, to obtain the guiding categories of the study (Health in inclusive education), which in turn facilitated the emergence of the sensitizing categories, to delimit the object of study and establish the comprehensive analysis of the connections revealed and interpret its results in the research.

With this sample, two instruments were applied at the beginning and in the first evaluative cut to parents about their family member with SEN associated or not to disability: a closed interview that contemplated: General data of their child (age, sex, weight, height, body mass index (BMI), problems of families and their participation in the education of their children), the second which measure the development of adaptive behaviour skills of students with Special Educational Needs (SEN), including indicators structured in the following categories: communication, hygiene and health, home life, social skills, use of community services, self-direction, self-care and safety, leisure and free time, and functional academic skills, under the leadership of researchers and students of the Special Education career.

The neutrosophic research method was used for sentiment analysis on interviews[15]. The Neutrosophic Research Method is a generalization of Hegel's dialectic. It suggests that scientific and humanistic research will advance via studying not only the opposite ideas but the neutral ideas related to them as well in order to have a broad picture of the whole problem to **solve**[16]**.**

3. Results

A pipeline using Orange Data mining[17] to analyze sentiment in interviews was developed. The sentiment analysis component predicts sentiment for each document in a corpus.

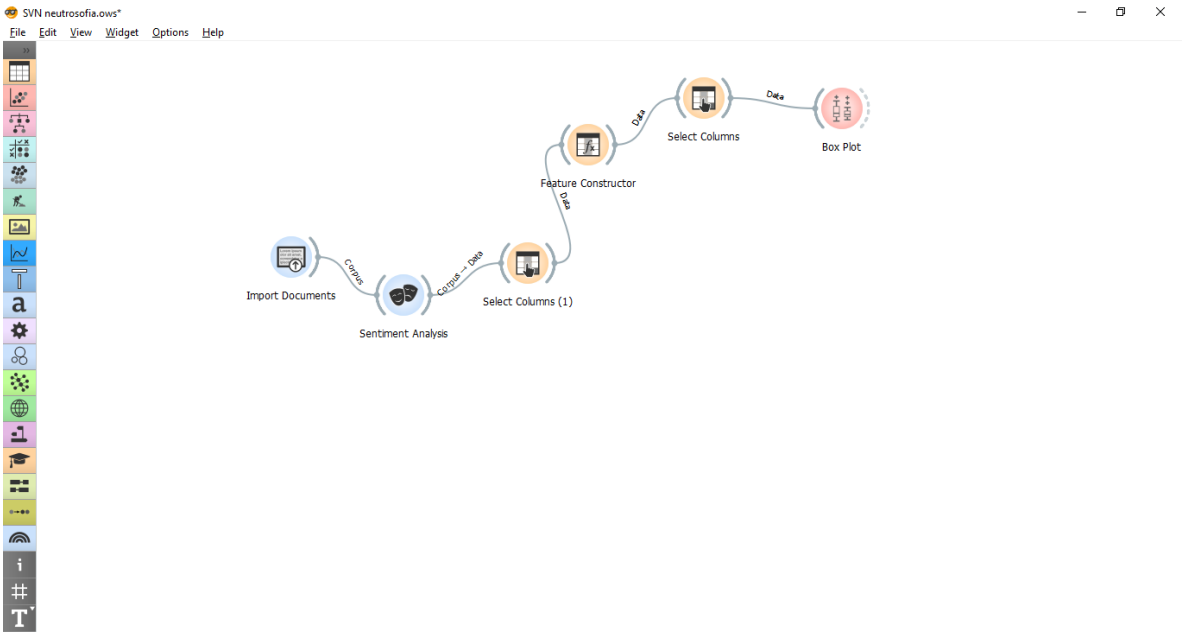

Figure 1. *Orange pipeline*

A group of 5 interviews were used, and as sentiment analysis, the VADER (Valence Aware Dictionary for Sentiment Reasoning text sentiment analysis) model is used [18]. VADER is sensitive to both polarity (positive/negative) and intensity (strength) of emotion. For convenience, a Single Value Neutrosophic Number (SVNS) in sentiment analysis is expressed as A = (pos, net, neg), where pos, net, and neg positive are positive, neutral and negative composite scores, respectively(Table 1).

Table 1. SVN number associated in interviews.

Case	SVN number
Case1	(0.052,0.909,0.04)
Case 2	(0.336,0.622,0.042)
Case 3	(0.044,0.814,0.142)
Case 4	(0,1,0)
Case 5	(0.075,0.746,0.179)

Scores of every interview were calculated using a feature contractor component

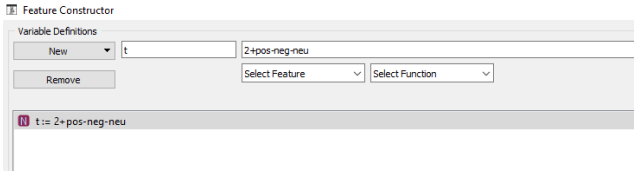

Figure 2. *Score calculation with* feature contractor component

The calculation results using Eq 4 as de-neutrification method [19] are shown in Figure 3.

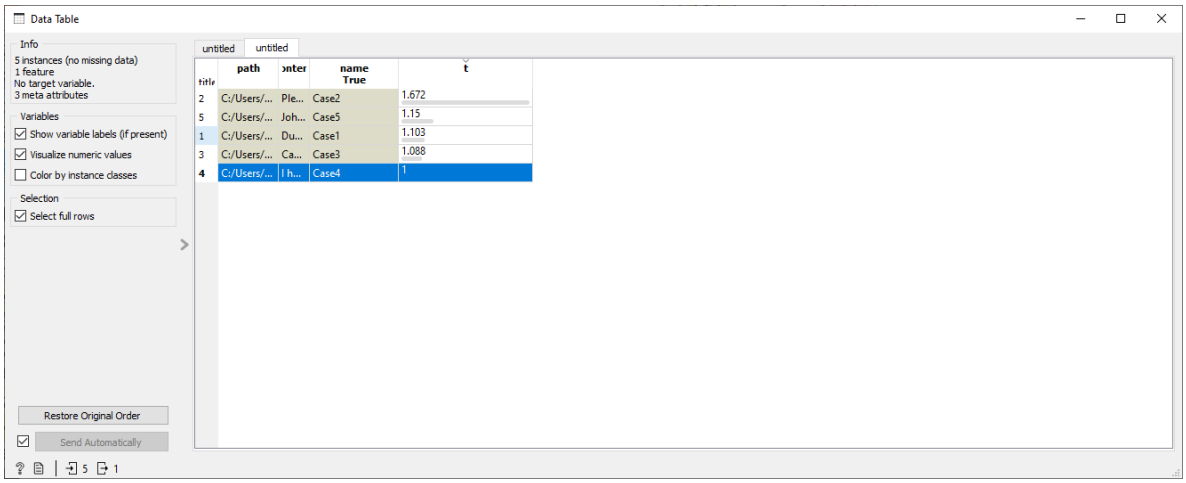

Figure 3. *Score calculation*

The methods show and sentiment score for every interview, that score function allow to rank single-valued neutrosophic numbers and gives a single numerical value. The researcher exploited a written interview transcript rich with observations and insights and quantified it using neutrosophy in conjunction with other research methods.

The highest scores are evidenced in the sensitizing categories Adaptive behaviour skills represented by leisure and free time with 12.43%, Social skills with 11.64% and main problems of families with 11.51%, while the relative values with the lowest scores are Health conditions with 1.35%, and Special Educational Needs to be associated or not with disability with 1.65%, which is coherent with the current reality, taking into account the deficiencies in the preparation of the family in the educational intervention of their children.

Within the adaptive behavioral skills of students with SEN associated or not to a disability, those indicators corresponding to leisure and free time skills and the development of social skills stand out because these areas in the initial state were depressed, constituting a causality of family conflicts, so they have been worked intensively, Although radical changes in the final state are not appreciated from their condition, both have evidenced reversed improvements in the other sensitizing categories studied, including the strengthening of family communication within and towards other families, a fundamental element of impact in terms of results.

Another of the statistical tools applied was the calculation of the emergency index[19], and upon studying the results, it was found that the highest incidence was due to the following:

· Main problems of families in the initial stage: indicators such as the following prevailed: parents' lack of knowledge of the developmental condition of their children and the support systems they need, generating disorientation, apathy, feeling of exclusion in the educational context, helplessness in educating their children (stress maintained in 100%, malnutrition due to obesity nine students (Morbid in 8 and 1 student Moderate), epilepsy, emotional disturbances, low self-esteem, insecurity in the work they do, low tolerance to the frustration of mistakes in parents and children, rejection of school, sadness, grief for the loss of family members with the pandemic, on the other hand, shows various disabilities with great diversity in terms of levels of development (age).

Although intellectual and developmental disabilities prevailed with more than 20% and adolescence as a complex stage within the development, although childhood was represented, all this determined

the design of the training system and the innovative and Educommunication activities articulated in the educational process in the initial stage.

In the final state, encouraging results were observed in the change of behavior of the families and the degree of training that they have acquired in carrying out activities with their children, especially those related to the management of technological and Educommunication tools, degree of acceptance towards their children, greater tolerance and resilience in the current historical context and consequently less frustration.

· Involvement of parents in their children's education: in this category, the evidence shows that, in the initial state, family actions were insufficient towards the education of their children, hostility, covert rejection, domestic violence (verbal and physical) prevailed, translated into the need to deepen in areas of conflicts and how to achieve peaceful coexistence in their family, evasion of the role that corresponded to them in the education of their children, resistance to change, no involvement in the educational processes of their children, therefore their participation as a family is focused on feeding, protecting, caring for their children and the formation of some values, as part of their cultural function, the rest was characterized by complaints towards the state and absence of activities that propitiate support systems in each of the students within the educational process, primarily those support actions directed to the use of virtual technological tools.

In the final state, each of the families has evolved according to their condition and reality, from each workshop given, coupled with various communication tools used, along with the specialized accompaniment of specialists in Pediatric Medicine, Psychology, Special Pedagogy, Technology, Sports in the various activities articulated to the workshops applied in each module with the following topics: 1st Module: Main problems of families and students with SEN associated with disability, 2nd Module: Support systems for educational inclusion and the 3rd Module: Curricular adaptations in virtual education and the family, together with the work carried out in a personalized way by researchers and students of the Special Education career in the pedagogical reinforcement applied in the 3rd module.

· The development of Adaptive Behavioral Skills in the initial state: were contemplated in the type: Communication, Hygiene and health, Homelife, Social skills, Use of community services, Self-direction, Self-care and safety, leisure and free time, Functional academic skills, each of them, were structured in an essential group of evaluative indicators, articulated at the time of evaluation to three categories (always, sometimes and never), this type of evaluation allowed catching the slightest result, a fundamental element that focused on observing the evolution of the process optimistically.

In the final stage of the study, the educational practice and the statistical tools presented above reveal the participation of each of these skills in 100% of the schoolchildren studied in more or less development, with those of the Communicative, Hygiene and health, Social skills, Self-care, Leisure and free time type standing out above the others due to their complexity and importance in the adaptation to the social environment, which was strengthened by the increased work of the family as the main protagonist of this historical context.

An essential element that stood out is the guiding role played by the reflections of each of the workshops applied by the specialists, systematically uploaded to the Blog, elaborated as an Educomunicasional tool for this project, the research group and the career of Special Education and how parents have been involved spontaneously in all this work, characterized by dialogue and active participation, high self-esteem of families who already consider themselves part of this educational process, which has led to the transformation of the modes of action and the improvement of healthier lifestyles.

4. Results

It is possible to evidence precisely the total dependence that exists between the guiding category (Health in educational inclusion) and the initial and final state of the sensitizing categories, in particular: the states of health, problematic of families before the role of educational care of their children with SEN associated or not to disability and the development of adaptive behaviour skills in preparation for the life of these schoolchildren as described by [20].

It is appropriate to highlight how social and emotional learning has gained greater prominence in the results of this study and demonstrates the postulates of the Social Learning Theory [21], pointing to the importance of this learning according to the guiding principles: Attention, retention, reproduction and motivation of the knowledge learned through observation and imitation of the closest people of these students, tinged by the emotional learning that is performed by identifying the expressions, and emotions that this knowledge brings to their routine life.

The digital inclusion of this population group (students with SEN associated with disability and their families) contributes significantly to the improvement of inclusive education and constitutes a gateway to work within the family, which should continue to be studied.

Its limitations remain to continue generating dynamics that systematically strengthen these aspects mentioned above, even outside this pandemic stage.

.This study is the first step of research that points out the uncertainties solving in discursive analysis. Results show the practical applicability of the proposal ease of use and interpretation by experts

Conclusions (

1. The *Transtheoretical model applied in health education* in the study has been represented by the interactivity, negotiation and active participation of each of the acting groups based on a relationship of respect, which has been the cornerstone in the action of the project, strengthening family and social communication in general and their change of healthier lifestyles.
2. The social and emotional learning facilitated by parents strengthens the development of adaptive behavior skills, generating active and coherent participation of these students, strengthening their inclusive education.
3. The continuity of training for parents should be continued, not with the intention that they assume the role of a specialist, but rather taking advantage of their role as a family so that they can incorporate new tools that stimulate their actions, sensitization towards working with their children in an assertive family environment, permeated with love, respect and understanding.
4. This study is the first step of research that points out the uncertainties in discursive analysis using a qualitative research approach in line with the Smarandache proposal. Datamining tool Orange was adapted to the neutrosophic environment.
5. Future work will concentrate on multi-refined neutrosophic set (MRNS) in interview sentiment analysis.

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