



Neutrosophic Psychology for Emotional Intelligence Analysis in Students of the Autonomous University of Los Andes, Ecuador

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Abstract. Emotional intelligence is a relatively recent and important concept in psychology, where the individual's ability to control his (her) emotions and to deal with the behavior of those around him (her) is taken into account. This implies a dynamic relationship between concepts such as the opposite which are rationality and emotion, where the emotionally intelligent individual would be located in the right middle of these two poles. A very recent way of representing these triadic relationships is the neutrosophical psychology theory, where if A is a psychological concept, the dynamical interaction of the concept is represented by the scheme ($\langle A \rangle \langle \text{Neut}A \rangle \langle \text{Anti}A \rangle$). This paper studies the behavior of the emotional intelligence in a group of university students from the Autonomous University of Los Andes in Ecuador using classical statistical inference tools, according to the triad ($\langle \text{EI} \rangle \langle \text{NeutEI} \rangle \langle \text{antiEI} \rangle$). The main motivation of this paper is to study the state of EI in the students of this university since a high EI will guarantee better future professionals and higher quality learning.

Keywords: Emotional intelligence, group emotional intelligence, neutrosophical psychology theory, higher education.

1 Introduction

Gardner ([1]) is the main exponent of the studies of the mind structure, he is the author who determined the eight multiple intelligences kinds, which are viz., bodily-kinesthetic, logical-mathematical, linguistic, naturalist, musical, spatial-visual, interpersonal and intrapersonal. With the support of multiple intelligences, according to Galera ([2]), learning-teaching models could be “modified (...), the academic performance would improve as the teaching would be more individualized, the skills of each student would be appreciated and we can work with every intelligence from the most outstanding ones.”

“The term Emotional Intelligence refers to the human ability to feel, understand, control and modify emotional states in oneself and also of others; emotional intelligence does not mean drown the emotions, but to direct and balance”, see [3].

Students have different forms of learning, therefore not all learn in the same way or at the same pace, in the case of standardized education, with a methodology for the group, teachers can show that there is a diversity of students with different needs, ways of thinking and learning, so there will always be those who do not assimilate the information at the same speed, causing low academic performance, to this end, the teacher must be prepared and trained to use strategies to level those that require special support, see [4-7].

The learning that articulates theory and practice is classified as the best strategy, that is why in the university classrooms, fieldwork is contemplated as part of the training process, as well as collaborative and group work, in this case, there are students with a low level of interpersonal intelligence who do not adapt to the groups, preferring to do them independently.

Goleman in [8], argues that the success of a professional, is not precisely for the one who has the best mark, but who manages human skills, of knowing how to relate to social groups, to be accepted, to work independently and in a group, who knows himself or herself and knows how to control emotions, therefore he/she raises questions about the education, about if it is valid to educate to: “learning to be”, “have”, “be”, or “co-create” in life.

This research analyses the emotional intelligence of students at the Autonomous University of Los Andes Ibarra extension, taking into account the importance of the management and control of personal emotions, the

ability to work as a team and the interrelationship between classmates because the educational environment is a variable that affects the quality of the training of professionals, as well as the assimilation of knowledge. The objective is to identify the management of interpersonal and intrapersonal intelligence and to determine the influence on the educational environment of the students of this university.

To this end, a survey was administered to 245 students of the faculties of accounting and auditing, tourism, management, system, and law, determining relevant factors, and sufficient to establish the management of emotional intelligence in this reference group.

The results of the survey were evaluated from the neutrosophic psychology, see [9], Neutropsyche is the psychological theory that studies the soul or spirit using the neutrosophy and neutrosophic theories, that is to say, Neutrosophic Psychological Theory. It is based on triadic neutrosophic psychological concepts of the form (<A>, <neutA>, <antiA>).

Neutropsyche Personality is a neutrosophic dynamic open psychological system of tendencies to feel, think, and act specifically to each individual, based on Neutrosophic Refined Memory: that restructures the division of memory into consciousness, aconsciousness (which is a blend of consciousness and unconsciousness), and unconsciousness. Aconscious is subdivided into preconscious, subconscious, semiconscious = semiunconscious, subunconscious, and preunconscious.

In other words, the Neutrosophic Psychological Theory studies the concepts of traditional psychology from a new point of view, from a triad of possible states (<A> <neutA> <antiA>), where <A> and <antiA> are considered opposite states of the concept, while the <neutA> state is considered neither <A> nor <antiA>, but an undetermined state. An example is the Freudian concept of "ego", where the triad (<id> <ego> <superego>) contains the ego as a state of balance between "id" and "superego". Smarandache renames the "id" as "underego", to define the triad (<underego> <ego> <superego>) with the intention of highlighting symmetry. This idea is generalized when using refined neutrosophy, where the aforementioned triad extends to more possible states, provided that at least one state of neutrality is included.

We used the tools of this theory to assess the results of the survey in terms of the emotional intelligence of the group of students. Despite our main interest is to obtain a collective measure of the individual EI degree in the group of students, this measure is a necessary and not sufficient measure of Group Emotional Intelligence (GEI), [10, 11]. GEI is defined in [10], as: "the ability to develop a set of norms that manage emotional processes to cultivate trust, group identity, and group efficacy. We argue that these collective beliefs facilitate the development of group member cooperation and collaboration." We follow the criterion that the greater the individual EI in the group, the greater the GEI.

The use of neutrosophic psychology has to do with the fact that the students in the group can clearly be considered either emotionally intelligent, or clearly emotionally non-intelligent, or a third option that is an intermediate-range of indefiniteness, therefore, here we will consider not only the <A> or <antiA> states but also the <neutA>, where A would mean emotional intelligence in the group, which we emphasize it is more particular than the GEI.

Beyond conducting a study on collective emotional intelligence in a student group, a theoretical contribution of this paper is to identify collective emotional intelligence as a concept whose states can be represented in the form of the aforementioned triad or by the refined neutrosophy. In this way, this paper represents this concept in the form of (<EI> <neutEI> <antiEI>), which means that the individual or the group possesses emotional intelligence, or an intermediate indeterminate state of emotional intelligence, or does not possess emotional intelligence, respectively.

This paper is divided into as follows; first, we have a section dedicated to exposing the main concepts of the Theory of Neutrosophic Psychology. The next section contains the results of the study of the emotional intelligence of students at the University of Los Andes, Ibarra extension, in Ecuador. The last section contains the conclusions.

2 Preliminaries

This section is dedicated to describing the psychological concepts used in this paper. Firstly, emotional intelligence is explained in subsection 2.1., whereas subsection 2.2. is devoted to explaining the main ideas on the Neutrosophical Psychology Theory.

2.1. Emotional Intelligence

Goleman ([12]) classifies emotional intelligence (EI) into intrapersonal and interpersonal, see Figure 1. Interpersonal intelligence is related to the way the person can interact with others, in the case of students, the empathy they have among their classmates, the ease of working as a team, the consensus obtained from the different debates, the respect of the ways of thinking, the ways of living and acting.

Interpersonal intelligence makes it possible to understand the others and communicate, taking into account their different moods, temperaments, motivations, and abilities, including the ability to establish and maintain social relationships and to assume different roles within groups. The important matter about analyzing

interpersonal intelligence is that like every behavior, it is transmitted from parents to children, especially from the models that the former create, it includes abilities such as empathy and the ability to manage interpersonal relationships, see [13].

Based on the aforementioned ideas, interpersonal intelligence is the ability to understand others and interact effectively with them. It “includes sensitivity to facial expressions, voice, gestures, and postures, and the ability to respond”, see [14]. On the other hand, intrapersonal intelligence, according to Campbell et al., see [15], has to do with “understand our thoughts and feelings. To the extent that we can raise our awareness, the relationship between our inner world and the outer world of experiences will be stronger”. Like it is stated in [12]: “The development of emotional, intrapersonal, indicates the way how the person manages and controls himself, according to the tools acquired from their environment, expressing their feelings appropriately and effectively.”

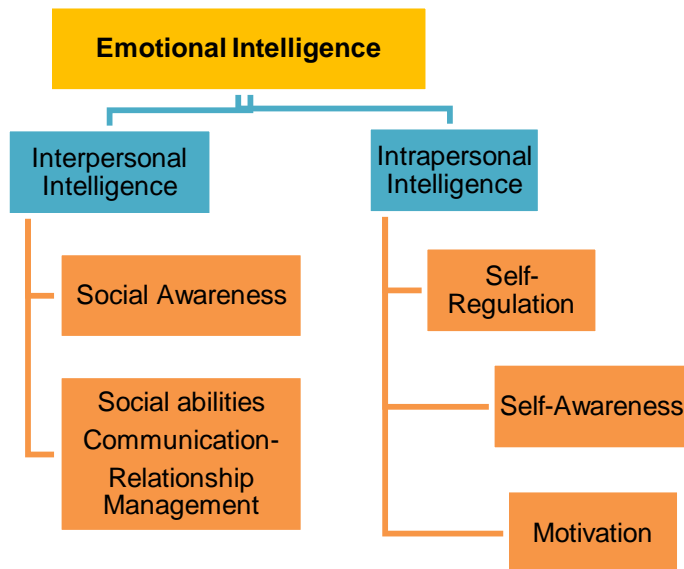


Figure 1: Emotional Intelligence components (Source [12])

The management of intrapersonal and interpersonal intelligence allows the individual to develop abilities and skills that differentiate him/her from other people, becoming worthy of society’s recognition. Thus, the good control of emotional intelligence allows establishing relationships of friendship, work, studies, to know how to behave, to manage their different moods and feelings.

The little development of the emotional intelligence in students has an impact on low performance in the area of emotional and academic, therefore it is important to know what are the emotions experienced during the academic day so that they can somehow modulate and manage emotions, develop tolerance to control the frustrations of every day, to adopt a positive attitude with classmates, or prevent interpersonal conflict, improve the quality of life of the university, sort out the feelings and states of mind.

2.2. Neutrosophical Psychology Theory: Basic Concepts

This section is dedicated to summarizing the main concepts and methods of the Neutrosophical Psychology Theory.

In [9] Smarandache makes reference to Sigmund Freud which divides memory into: conscious, preconscious, and unconscious. In the framework of neutrosophic psychology, it is defined as a third state which is called “aconscious”, which means: to be ignorant, impassive, indifferent, senseless, and unfeeling.

Similarly, to the neutrosophic theory, neutrosophic psychology deals with concepts represented by $\langle A \rangle$, $\langle \text{neut}A \rangle$, $\langle \text{anti}A \rangle$, one of them is described as follows:

- 1) Conscious, meaning things that we are currently aware of, it corresponds to $\langle A \rangle$.
- 2) Unconscious, which comprises things that we are not aware of; they are hard to access because they are deep inside our minds. It is the opposite of conscious, corresponding to $\langle \text{anti}A \rangle$.
- 3) Aconscious, which etymologically means away from conscious and unconscious, or neither conscious nor unconscious, but in between, or a mixture of conscious and unconscious, a vague buffer zone between them. It corresponds to $\langle \text{neut} A \rangle$ or Indeterminacy, as in Neutrosophy.

Thus, the consciousness, aconsciousness, and unconsciousness are the sources of positive, neutral (or blended), and negative emotions, thoughts, and behaviors throughout our lifespan.

In human behavior, there exists a permanent interaction and discussion among conscious, unconscious, and aconscious. Sometimes people are mostly rational, sometimes they are mostly irrational, and others are indifferent.

The triple $(\langle A \rangle, \langle \text{neut } A \rangle, \langle \text{anti } A \rangle)$ is extended to the *discrete refined neutrosophic memory*, where $(\langle A \rangle_1, \langle A \rangle_2, \dots, \langle A \rangle_n; \langle \text{neut } A \rangle_1, \langle \text{neut } A \rangle_2, \dots, \langle \text{neut } A \rangle_m; \langle \text{anti } A \rangle_1, \langle \text{anti } A \rangle_2, \dots, \langle \text{anti } A \rangle_n)$ are defined based on the refined neutrosophy, see [9, 16-17].

Also Smarandache in [9] cites Carl Jung who divided the unconsciousness into ([18]):

- Personal unconscious, which is specific to each individual, and comprises forgotten or suppressed conscious;
- Collective unconsciousness, which is characteristic to the whole human species, and comprises ancestral memories called “archetypes” (universal meaning images) and mental patterns as inherited psychic structures.

Smarandache adds the group unconscious, which is:

- Group unconsciousness, which is between the personal and collective unconsciousness. It is characteristic to a specific group that the individual belongs to, and has marked him/her mostly.

Equivalently, he extends the Jung’s personal conscious and collective conscious to group conscious.

The unconsciousness has a degree of conscious (c), and a degree of the unconscious (u), where $c \in [0,1]$, and $0 \leq c + u \leq 2$.

In the neutrosophic psychology there is the following notation:

$$NL(\text{entity}) = (c, a, u) \quad (1)$$

Where c = degree of conscious (truth), a = degree of unconscious (indeterminacy): not sure if it is conscious or unconscious, or a blend of both, and u = degree of the unconscious (falsehood), whereas, NL is the notation for Neutrosophic Logic semantic ([19,20]).

$NL(\text{conscious}) = (1, 0, 0)$; $NL(\text{unconscious}) = (0, a, 1)$, where $a \in (0, 1]$, leaving room for indeterminacy (unknown, unclear).

Given U a universe of discourse, A , B , and C subsets, then Neutrosophic Crisp Set of Type 2 satisfies the axioms: $A \cap B = \emptyset$, $B \cap C = \emptyset$, $C \cap A = \emptyset$, and $A \cup B \cup C = U$. Therefore, A , B , C form a disjoint partition of the universe of discourse U .

Refined Neutrosophic Crisp Set of Type 2 (and similarly for Types 1 and 3) is defined as: $A = A_1 \cup A_2 \cup \dots \cup A_p$, $B = B_1 \cup B_2 \cup \dots \cup B_r$, $C = C_1 \cup C_2 \cup \dots \cup C_s$, with $A \cap B = B \cap C = C \cap A = \emptyset$, where p, r, s are integers ≥ 1 , $p + r + s \geq 4$, and $A_i \cap A_j = \emptyset$ for $i, j \in \{1, 2, \dots, p\}$, $i \neq j$; $B_k \cap B_l = \emptyset$ for $k, l \in \{1, 2, \dots, r\}$, $k \neq l$; and $C_m \cap C_n = \emptyset$ for $m, n \in \{1, 2, \dots, s\}$, $m \neq n$.

The Neutrosophic Crisp Personality considers a human person as a universe of discourse U , and three disjoint sets which are the following ([9, 21]):

E = set of emotions of this person;

H = set of thoughts of this person;

B = set of behaviors of this person.

Therefore, $U = E \cup H \cup B$, with $E \cap H = \emptyset$, $H \cap B = \emptyset$, and $B \cap E = \emptyset$. Thus, $U = \langle E, H, B \rangle$.

Also, the trait is measured by degrees of $\langle \text{trait} \rangle$ and degrees of $\langle \text{anti trait} \rangle$, such that each person is classified in a range between these two opposites and it is dynamic. Additionally, they include a middle position where there exists indeterminacy.

The most common pair trait-anti trait, are the following:

- Extraversion – Introversion
- Conscientiousness – Unconscientiousness
- Perfectionism – Imperfectionism
- Sensitivism – Insensitivism
- Novator – Conservator
- Self Esteem – Self NonEsteem
- Agreeableness – Disagreeableness
- Openness to Intellect & Experience – Closeness to Intellect & Experience
- Inhibition – Disinhibition
- Flexibility – Rigidity
- Emotivism [Neuroticism (Hans Eysenck)] – Non-Emotivism
- Obsessionality – Nonobsessionality
- Cautiousness – Impulsivity
- Shyness – Boldness
- Honesty – Dishonesty
- Hostility [Psychoticism (Hans Eysenck)] – Nonhostility.

The *Neutrosophic Trait Operator* is the cumulative degree of individual x concerning both the Trait and the antiTrait, and it is defined as:

$$d_{\text{Trait \& antiTrait}}: S \rightarrow [-1, 1] \quad (2)$$

Where, $d_{\text{Trait \& antiTrait}}(x) = d_{\text{Trait}}(x) + d_{\text{antiTrait}}(x)$.

To classify an individual as belonging to the trait or the anti trait, a threshold is defined and denoted by Thr

for the trait, and antiThr for the anti trait, so that:

- If $d_{Trait\&antiTrait}(x) \geq +Thr$, then the individual is categorized as definitively belonging to the Trait,
- If $d_{Trait\&antiTrait}(x) \leq -antiThr$, then the individual is categorized as definitively belonging to the antiTrait.
- If $d_{Trait\&antiTrait}(x) \in (-\varepsilon, +\varepsilon)$, then the individual is categorized as been in a totally indeterminate state between the Trait and antiTrait.
- If $d_{Trait\&antiTrait} \in (\varepsilon, Thr)$, then the individual is categorized as mostly belonging to the Trait.
- If $d_{Trait\&antiTrait}(x) \in (-antiThr, -\varepsilon)$, then the individual is categorized as mostly belonging to the antiTrait.

The way to deal with $d_{Trait\&antiTrait}$ is illustrated as follows:

“Assume a psychiatrist, after many sessions, neutrosophic questionnaires and observations measured with neutrosophic statistics, has gotten to the conclusion that George P.’s two temperament dimensions are estimated with a certain accuracy as:

- degree of stable (trait) is $d_{GP}(stable) = 0.2 \in [0, 1]$,
- degree of unstable (antiTrait) is $d_{GP}(unstable) = -0.5 \in [-1, 0]$;and
- degree of extroverted (trait) is $d_{GP}(extroverted) = 0.9 \in [0, 1]$,
- degree of introverted (antiTrait) is $d_{GP}(introverted) = -0.3 \in [-1, 0]$.

Then $d_{GD\langle stable \rangle \& \langle unstable \rangle}(x) = d_{GP}(stable) + d_{GP}(unstable) = 0.2 + (-0.5) = -0.3$, and $d_{GD\langle extroverted \rangle \& \langle introverted \rangle}(x) = d_{GP}(extroverted) + d_{GP}(introverted) = 0.9 + (-0.3) = +0.6$.”

3 Results and Discussion

From now on, this section contains the results and discussion for measuring the emotional intelligence in students of The Autonomous University of Los Andes, Ecuador.

3.1. Results

In this subsection, it is described the results obtained from the survey and its processing using statistical and neutrosophic psychology tools. The details of the statistical sampling are the following:

The population under study was made up of 674 students of the Autonomous University of Los Andes, Ibarra extension, being a relatively large number; the sample was calculated using formula 3.

$$n = \frac{Nz^2pq}{d^2(N-1)+z^2pq} \quad (3)$$

Where:

N = Size of the students' population (674).

z = 1.96 (95% confidence level).

p = probability of success (in this case 50% or 0.5).

q = 1 - p (in this case 1-0.5 = 0.5).

d = Permissible error (5% or 0.05).

$$n = \frac{674 * 1.96^2 * 0.5 * 0.5}{0.05^2 * (674-1) + 1.96^2 * 0.5 * 0.5} \approx 245$$

Let us recall that Equation 3 is widely used to calculate the size of a random sample drawn from the population being studied so that this sample is significant for the entire population. The value of z is obtained as the confidence level according to the values of the standard normal distribution N (0, 1). d is the sampling error, the smaller it is, the more accurate the inference of the population parameters will be from the calculated parameters of the extracted sample. The value of p corresponds to the proportion of elements in the population that satisfy the study characteristic, while q is the proportion of those that do not. When this proportion is unknown, p = q = 0.5 is considered, [22].

The data collection technique was the semi-structured survey, consisting of three informative questions such as age, career, and course, as well as 15 questions related to the management of intrapersonal and interpersonal intelligence. The instrument was applied to 245 students of the full-time teaching modality, of the studies of accounting and auditing, administration, systems, tourism, and law.

The following variables were measured according to the questions that were asked in the survey, where the used measurement scales appear between parentheses:

V₁: Knowledge about emotional intelligence (Much, More or less, Little, Nothing),

V₂: Relationship with classmates (Very good, Good, Regular, Bad),

V₃: Tolerance to their peers for their way of being (Much, More or less, Little, Nothing),

V₄: Relationship with classmates and forms of work (Very good, Good, More or less, Bad),

V₅: Sudden mood swings (Common, Uncommon, Never),

V₆: Extra-verbal demonstration form of problems (To know how to control the impulses, Gestures, Sweating, Actions, Expressions),

V₇: Emotions during the exhibitions (Adequate, Tremors, Sweating, Stress, Headaches).

Each of the above results was classified as an Emotional Intelligence Indicator (Much, Very Good, Good, Never, Uncommon, To know how to control the impulses, and Adequate), which are denoted by <EI>, Indicator of Emotional Non-Intelligence (Little, Nothing, Bad, Frequent, Common, Gestures, Sweating, Actions, Expressions, Tremors, Sweating, Stress,), which are denoted by <Anti EI>, and finally indicators of indeterminacy denoted by <Neut EI>, which are (More or less, Regular).

The results of the survey were shown in Table 1.

Variable	<EI>	<Neut EI>	<Anti EI>
V ₁	51%	10%	39%
V ₂	57%	4%	39%
V ₃	63.8%	6%	30.2%
V ₄	89%	5%	6%
V ₅	50.6%	0%	49.4%
V ₆	49%	0%	51%
V ₇	72%	0%	28%

Table 1: Results of the survey classified in percent of <EI>, <Neut EI>, and <Anti EI> responses.

The results in Table 1, were processed as follows:

1. The data were divided by 100, to normalize in the interval [0, 1].
2. The normalized <Anti EI> values are multiplied by -1, the normalized <EI> values remain positive. An index was determined for each of the variables with the support of formula 2, with $d_{<EI>&<Anti EI>}(x)$.
3. The general state of the individual Emotional Intelligence for the members of the group of study is calculated by the mean of the values of the previous point, thus, the mean over <EI>, and over <Anti EI> are calculated, and formula 2 is applied to the results.

Let us note that the extension to the interval [-1, 1] corresponds to the bipolar representation of neutrosophy, [16].

The calculations are given in Table 2.

Variable	<EI>	<Neut EI>	<Anti EI>	$d_{<EI>&<Anti EI>}$
V ₁	+0.51	0.10	-0.39	0.12
V ₂	+0.57	0.04	-0.39	0.18
V ₃	+0.638	0.06	-0.302	0.336
V ₄	+0.89	0.05	-0.06	0.83
V ₅	+0.506	0.00	-0.494	0.012
V ₆	+0.49	0.00	-0.51	-0.02
V ₇	+0.72	0.00	-0.28	0.44
Aggregated results	+0.61771	0.035714	-0.34657	0.27114

Table 2: Processing of <EI>, <Neut EI>, and <Anti EI>, utilizing $d_{<EI>&<Anti EI>}$ for each variable and the final result.

It can be seen that according to Table 2, although the <EI><Anti EI> balance is favorable to the first one, the index 0.27114 is not very high, where the variables V₁, V₂, V₅, and V₆, are either negative or not high.

3.2. Discussion

The subject of neutrosophic psychology is still unexplored in terms of creating tools to study classical branches of psychology from this novel point of view. In this paper, we have set out to address the issue of collective emotional intelligence in student groups at a university in Ecuador. Basically, it is a statistical study where the data is processed in a non-classical way. Instead of interpreting the results according to the percentage of students who meet certain characteristics that indicate emotional intelligence, this paper proposes a neutrosophic approach where explicitly takes into account the intermediate state of indeterminacy or borderline.

It is important to consider this borderline state because we are studying a complex phenomenon, which depends not only on the personality of the group members but also on the social interaction among them; see [23-25]. The complexity is also consequence of the way that classmates and teachers are gathered, which is not based on

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empathy or spontaneity. On the other hand, classic statistical study allows us to make inferences on the situation of a population regarding certain characteristics that are investigated at a certain moment in the time, and do not consider the dynamic of human interactions.

Borderline states in dynamic phenomena are indeterminate, imprecise, thus, we cannot predict easily what the trend of the phenomenon is, either to a desirable state or an undesirable state. In this research, there is an indeterminate state of existence of group emotional intelligence, since the obtained index is not high, which is why the result is very close to being borderline, and therefore we do not know if the groups evolve to a not emotional intelligence state, or conversely if the collective emotional intelligence will be reinforced.

Let us point out that the study that is carried out can be deepened even more, where two rational principles are followed, but they need to be corroborated experimentally. These principles are, (1) We considered that the variables used to measure emotional intelligence in this paper are sufficient to measure the collective emotional intelligence of a group of university students (2) A high individual emotional intelligence of all students positively entails a high collective emotional intelligence. Both principles deserve a deeper study, although in this research they are regarded as axioms because of their rationality.

An interesting matter to explore in the future is to substitute the classical statistic by the emergent neutrosophic statistics, which is applied in many fields, see [26-30].

Conclusion

This paper was dedicated to analyze and evaluate emotional intelligence in a group of 245 randomly selected students at the Autonomous University of Los Andes, Ibarra extension, Ecuador. The study was conducted through a survey of these students, to measure seven variables, the results of which were classified as Emotional Intelligence indicator (<EI>), non-Emotional Intelligence indicator (<Anti EI>), and Indeterminate (<Neut EI >). The balance <EI><Anti EI> was calculated, for each variable as well as the total average, and the following deficiencies were detected:

- There is not sufficient knowledge of the concept of emotional intelligence in the group.
- The relationship among classmates is not sufficiently good.
- Students have sudden mood swings in a manner not sufficiently adequate.
- The extra-verbal demonstration of problems is slightly negative.

Because a significant random sample of the student population was used, these results can be generalized to the entire student population of the University.

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