A Study of the Relationship Between Cultural Identity and Intercultural Attitude Based on Plithogenic Statistics

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Abstract

This research is carried out at the Educational Institution No. 35005 Reverend Father Bardo Bayerle of the Province of Oxapampa, Peru. We demonstrate that when there is a strong cultural identity, this means that the intercultural attitude of students is also strengthened. Cultural identity is a value that is currently being lost. This is a negative phenomenon, since with the reaffirmation of what one is culturally then one can consolidate the relationship with other groups. In this paper this phenomenon is studied from a statistical perspective on a survey carried out on students of this institution, some of them belonging to the target group and others belonging to the control group. To obtain more reliable results we apply Plithogenic Statistics, which is a generalization of Multivariate Statistics, where more than one random variable is studied simultaneously. Specifically, plithogenic statistics incorporates new components within the statistical study such as falsity or indeterminacy.

Keywords: Cultural Identity; Intercultural Attitude; Plithogenic Probability; Plithogenic Statistics; Multivariate Statistics; Plithogeny; Neutrosophic Number.

1 Introduction

According to various authors, currently, the issue of cultural identity has acquired crucial importance in the educational field. Education in cultural identity seeks to form citizens of the world who recognize and value cultural and social diversity as an enriching element for a democratic society. Therefore, to address this issue, it is essential to consider the causes of identity crises, which can be divided into two types: crises that occur during adolescence, characterized by the search for meaning and individuality, and those that result from personal adaptation after the loss of someone close due to abandonment, separation or death. In addition, the lack of knowledge about the traditions, values, and beliefs, as well as the rituals, customs, or behaviors of their community of origin, can also be an influencing factor.

The loss of cultural identity can manifest itself in various ways, such as interest in cultures other than one's own, which especially affects young people belonging to indigenous communities. Furthermore, the lack of roots leads to the disappearance of towns, since people's identity is directly affected by abandoning the places where they were born and educated, and where they shared fundamental experiences with their family, friends, and community.

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The purpose of the research is to demonstrate that strengthening cultural identity contributes to fostering an intercultural attitude among students of the aforementioned institution.

This research on cultural identity is crucial since it provides a space to reflect on knowledge, beliefs, art, law, morals, customs, and other aspects that make up the lives of people in a society, to strengthen an intercultural attitude in students. This research is carried out at Educational Institution No. 35005 Reverend Father Bardo Bayerle of Oxapampa–Pasco, Peru. We demonstrate that cultural identity strengthens the intercultural attitude of the students of this school, which is demonstrated with a statistical study of a survey carried out on a sample of students from this center.

We decided to base this study on a relatively new theory called Plithogenic Statistics that generalizes Multivariate Statistics [1-3]. Several reasons lead us to use this tool, the first one has to do with the multidimensionality of the phenomenon we study. It is known that the cultural identity of an ethnic group, region, country, continent, etc., can be studied from different disciplines such as anthropology and sociology. This phenomenon is based on some characteristics of the community that are studied by disciplines such as psychology, social and economic dynamics, and cultural heritage, among others. Thus, plithogeny is the tool used here, because it generalizes the study of dynamics from dialectic that contains only two components, adding a third component of neutrality that also interacts with a concept and its opposite. Plithogeny also studies the interaction of a concept <A> with another <B>, with its opposite <AntiB> or with its neutral <NeutB>, and so on [4].

On the other hand, Plithogenic Statistics generalizes Multivariate Statistics where the different components or variables of the problem as a whole are studied, but this time incorporating in some way some component of falsity or indeterminacy [1]. This makes the results obtained from Plithogenic Statistics more closely related to the reality of the phenomenon that is studied. The relevance of plithogenic theory is evidenced in [5-14].

2 Materials and Methods

Plithogenic Statistics (PS) comprises the analysis and observations of the events studied by the Plithogenic Probability [1].

Plithogenic Statistics generalizes classical MultiVariate Statistics, and in turn, allows an analysis of many output variables that are neutrosophic or indeterminate. It is also a multi-indeterminate statistic.

Various subclasses of Plithogenic Statistics are as follows:

- Multivariate Statistics,
- Plithogenic Neutrosophic Statistics,
- Plithogenic Indeterminate Statistics,
- Plithogenic Intuitionistic Fuzzy Statistics,
- Plithogenic Picture Fuzzy Statistics,
- Plithogenic Spherical Fuzzy Statistics,
- and in general: Plithogenic (fuzzy-extension) Statistics,
- and Plithogenic Hybrid Statistics.

On the other hand, Plithogenic Refined Statistics are the most general form of statistics that studies the analysis and observations of events described by Plithogenic Refined Probability.

In classic inference statistics, the population's average of the variable is estimated from the sample's average.

When there is a classic random variable, the exact size of the sample is known and all the elements in the sample belong 100% to the population. However, this does not reflect the dynamics of a population such as the student population, which is the example illustrated by F. Smarandache, where there is fluctuation of students within the courses, in addition to the fact that the membership of each student varies depending on whether they are studying in a course full-time, part-time or over-time [1].

In a Neutrosophic Population, each element has a triple probability of membership (T_j, I_j, F_j), where $T_j, I_j, F_j \in [0,1]$ such that $0 \leq T_j + I_j + F_j \leq 3$.

If we assume that we have the data set (T_j, I_j, F_j) for $j = 1, 2, \dots, n$, where n is the sample size, then the average probability for all data in the sample is calculated by Equation 1.

$$\frac{1}{n}\sum_{j=1}^{n}(T_j, I_j, F_j) = \left(\frac{\sum_{j=1}^{n} T_j}{n}, \frac{\sum_{j=1}^{n} I_j}{n}, \frac{\sum_{j=1}^{n} F_j}{n}\right) \quad (1)$$

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In this research, we also consider some operations in the form of *neutrosophic numbers*. These ways of representing indeterminacy, under certain conditions are equivalent to working with intervals.

Definition 1: ([15-16]) A *neutrosophic number* N is defined as a number as follows:

$$N = d + I \quad (2)$$

Where d is called the *determined part* and I is called the *indeterminate part.*

Given $N_1 = a_1 + b_1 I$ and $N_2 = a_2 + b_2 I$ are two neutrosophic numbers, some operations between them are defined as follows:

$N_1 + N_2 = a_1 + a_2 + (b_1 + b_2)I$ (Addition);

$N_1 - N_2 = a_1 - a_2 + (b_1 - b_2)I$ (Difference),

$N_1 \times N_2 = a_1 a_2 + (a_1 b_2 + b_1 a_2 + b_1 b_2)I$ (Product),

$\frac{N_1}{N_2} = \frac{a_1 + b_1 I}{a_2 + b_2 I} = \frac{a_1}{a_2} + \frac{a_2 b_1 - a_1 b_2}{a_2(a_2 + b_2)} I$ (Division).

Furthermore, the arithmetic operations between intervals are important in this paper, which are summarized below ([17,18,19]):

Given $I_1 = [a_1, b_1]$ and $I_2 = [a_2, b_2]$ we have the following operations between them:

$I_1 \leq I_2$ if and only if $a_1 \leq a_2$ and $b_1 \leq b_2$.

$I_1 + I_2 = [a_1 + a_2, b_1 + b_2]$ (Addition);

$I_1 - I_2 = [a_1 - b_2, b_1 - a_2]$ (Subtraction),

$I_1 \cdot I_2 = [\min\{a_1 \cdot b_1, a_1 \cdot b_2, a_2 \cdot b_1, a_2 \cdot b_2\}, \max\{a_1 \cdot b_1, a_1 \cdot b_2, a_2 \cdot b_1, a_2 \cdot b_2\}]$ (Product),

$I_1 / I_2 = I_1 \cdot (1/I_2) = \{a/b: a \in I_1, b \in I_2\}$, always that $0 \notin I_2$(Division).

3 The Study

The population under study is made up of all the students (339) from 1st to 5th grade of secondary education of Educational Institution No. 35005 Reverend Father Bardo Bayerle of Oxapampa–Pasco. The sample was made up of 34 students from the 5th year "A" and 34 from the 5th year "B", making a total of 68 students. The sampling technique is non-probabilistic and is used at the researcher's discretion.

The method used was the survey since it is a quantitative research method and the researcher collects the data using an already created questionnaire. The questionnaire was developed according to the objectives and dimensions of the dependent variable, with approximately 25 items, which will be administered as a pretest and post-test to both, the control and experimental group. The questionnaire has the following order:

1. The "Affective Communication" dimension consists of 7 items,
2. The dimension "Exchange of Knowledge and Experiences" consists of 6 items,
3. The "Social Coexistence" dimension consists of 7 items,
4. The "Consensus of Differences" dimension consists of 7 items.

The age of the students was taken into account and therefore the limitation they may have in understanding neutrosophic methods. That is why they were asked to express their opinions according to a range of values instead of a single value on a continuous numerical scale from 0 (Never) to 10 (Always). These intervals are expressed in the form $I_i = [a_{iL}, a_{iU}]$ for each of the respondents.

The validation of the instruments for data collection was carried out according to the judgment of experts with a PhD degree. The reliability of the instruments was subjected to Cronbach's Alpha reliability analysis. In the end, the result indicates that the instrument to be used is reliable. The survey was administered once to the control group and twice to the target group. Specifically, the survey was administered to the target group before any activity was carried out. Later, this group was the subject of a program of teaching special classes on native cultures, where their values were highlighted. Cultural activities were also carried out such as participation in typical cultural expressions, visits to museums, and visits to communities where the functioning of these native cultures can be seen firsthand, elders were interviewed, who explained and motivated the students to learn about these cultures, among many other activities.

The last moment consisted of administering the survey to the members of the experimental group. All this data was collected to be processed by the researchers. The steps shown below were followed:

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1. The different variables are specified for the dimensions to be measured:
$S = \{s_1, s_2, \ldots, s_{34}\}$ denotes the set of students in the study group.
$\tilde{S} = \{\tilde{s}_1, \tilde{s}_2, \ldots, \tilde{s}_{34}\}$ denotes the set of students in the control group.
$d = \{d_1, d_2, d_3, d_4\}$ denotes the set of dimensions to be measured, such that:
d_1: Symbolizes the "Affective Communication" dimension,
d_2: Symbolizes the dimension "Exchange of Knowledge and Experiences",
d_3: Symbolizes the dimension "Social Coexistence",
d_4: Symbolizes the "Consensus of Differences" dimension.
Each of these elements in d is a set of items in itself, where:

$d_1 = \{d_{11}, d_{12}, \ldots, d_{17}\}$ is the set of items of the first dimension (d_{1j} represents Dimension 1 j^{th} item),

$d_2 = \{d_{21}, d_{22}, \ldots, d_{26}\}$ is the set of items of the second dimension (d_{2j} represents Dimension 2 j^{th} item),

$d_3 = \{d_{31}, d_{32}, \ldots, d_{37}\}$ is the set of items of the third dimension (d_{3j} represents Dimension 3 j^{th} item),

$d_4 = \{d_{41}, d_{42}, \ldots, d_{47}\}$ is the set of items of the fourth dimension (d_{4j} represents Dimension 4 j^{th} item).

In this way, the evaluations for each item are represented by:

$I_{ijk} = [a_{ijkL}, a_{ijkU}]$, which is the evaluation of the i^{th} student in the target group for the k^{th} item of the j^{th} dimension.

Its equivalent notation for the control group is $\tilde{I}_{ijk} = [\tilde{a}_{ijkL}, \tilde{a}_{ijkU}]$.

2. The dimension scores were obtained for each respondent and each dimension using the following expression:

$$D_{ji} = \sum_{k=1} I_{ijk} \qquad (3)$$

D_{ji} is the score of a variable or dimension j for respondent i. This score is obtained by the arithmetic sum of all the k items of the variable or dimension j, answered by respondent i, using the sum of intervals.

Equivalently, we have the results for the control group:

$$\tilde{D}_{ji} = \sum_{k=1} \tilde{I}_{ijk} \qquad (4)$$

3. Since the dimensions and variables have different numbers of items, the scores are transformed into a range from 0 to 100 using the following expression for the study group:

$$D_{ji}^{*} = \frac{D_{ji} - \text{minima puntuación teorico } D_j}{\text{maximo puntuación teorico } D_j - \text{minimo puntuación teorico } D_j} * 100 \qquad (5)$$

Where: D_{ji}^{*} is the transformed score for variable or dimension j for respondent i.

In the same way, we have Equation 6 for the control group.

$$\tilde{D}_{ji}^{*} = \frac{\tilde{D}_{ji} - \text{minima puntuación teorico } \tilde{D}_j}{\text{maximo puntuación teorico } \tilde{D}_j - \text{minimo puntuación teorico } \tilde{D}_j} * 100 \qquad (6)$$

These transformations allow the scores of the variables or dimensions to have the same range of values regardless of their number of items so that 0 represents the minimum level and 100 is the maximum level. That is, these new scores are the proportion of the dimension or variable valued by the respondents.

To have an index of difference between the study group before and after passing the program and on the other hand to measure the difference between the control group and the study group, the following indices were defined:

$\overline{D}_j^{*}$ denotes the average of the results for the j^{th} dimension for the study group and is calculated by the following formula:

$$\overline{D}_j^{*} = \frac{\sum_{i=1}^{34} D_{ji}^{*}}{34} \qquad (7)$$

Equivalently for the control group we have:

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$$\bar{\bar{D}}_j^* = \frac{\sum_{i=1}^{34} \tilde{D}_{ji}^*}{34} \quad (8)$$

To measure the change produced before and after passing the program for the study group, formula 9 is used:

$$\bar{\Delta}_j^* = \bar{D}_{jafter}^* - \bar{D}_{jbefore}^* \quad (9)$$

Where $D_{jiafter}^*$ denotes the scores of the study group after passing the program, while $D_{jibefore}^*$ is the previous results.

While:

$$\bar{\bar{\Delta}}_j^* = \bar{D}_j^* - \bar{\bar{D}}_j^* \quad (10)$$

Denotes the difference between the averages of the study group with the control group.
Once the indices that we use to measure these results have been defined, the calculations carried out indicate the following, see the figures below:

Figure 1 indicates the percentages in interval form achieved for the "Affective Communication" dimension.

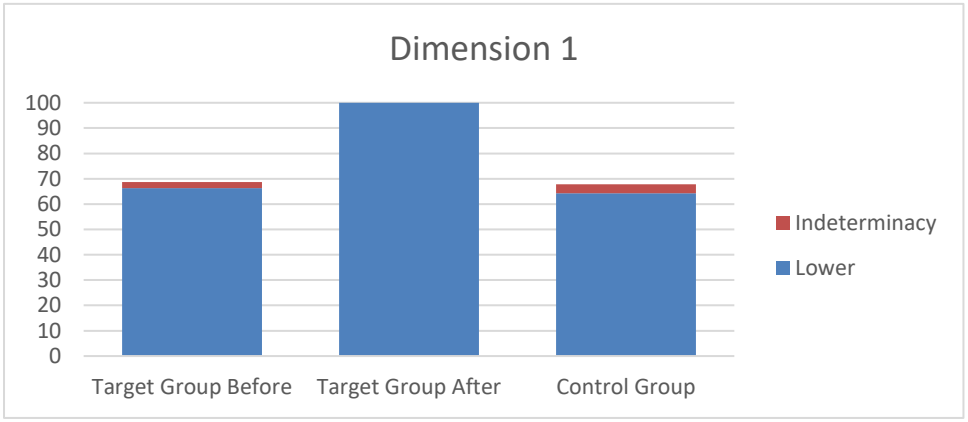

Figure 1: Results of the average of the Target Group before and after passing the program and of the Control Group for Dimension 1. In blue it is the determined percentage and in red it is the indeterminate percentage.

Figure 2 is the result of the Dimension "Exchange of Knowledge and Experiences".

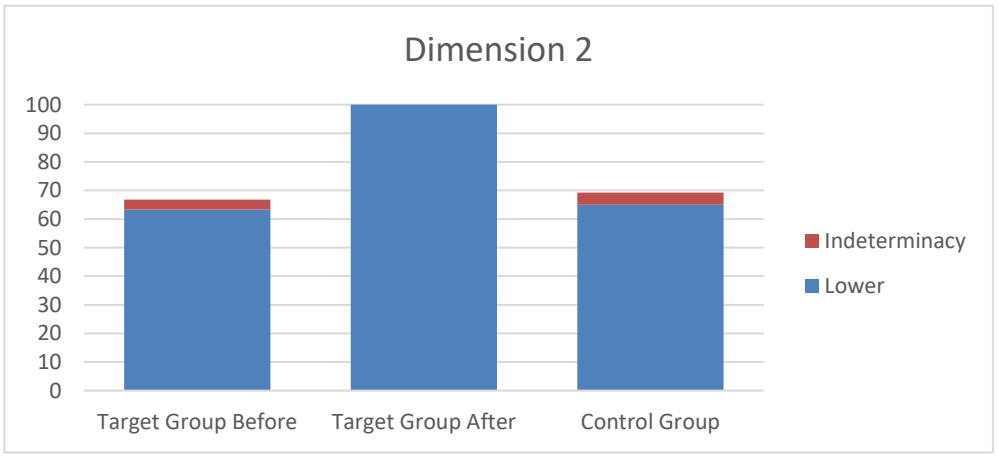

Figure 2: Results of the average of the Target Group before and after passing the program and of the Control Group for Dimension 2. In blue it is the determined percentage and in red it is the indeterminate percentage.

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Figure 3 refers to the results of the Dimension: "Social Coexistence".

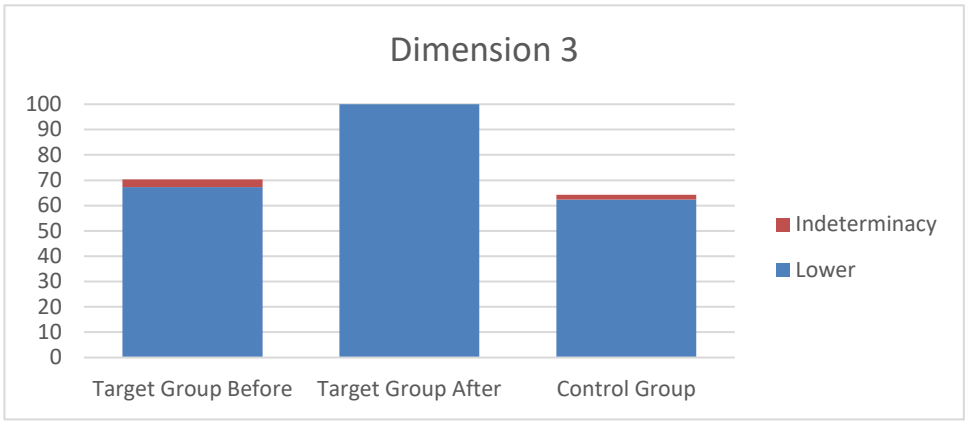

Figure 3: Results of the average of the Target Group before and after passing the program and of the Control Group for Dimension 3. In blue it is the determined percentage and in red it is the indeterminate percentage.

Figure 4 is the result related to the "Consensus of Differences" dimension.

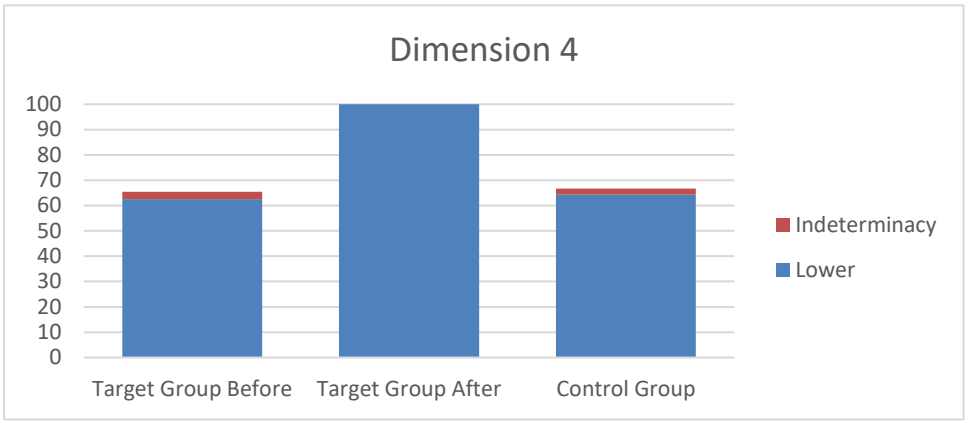

Figure 4: Results of the average of the Target Group before and after passing the program and of the Control Group for Dimension 4. In blue it is the determined percentage and in red it is the indeterminate percentage.

Thus using the difference between intervals we have:

- $\overline{\Delta}_1^* = [100, 100] - [66.33, 68.73] = [31.27, 33.67]$,
- $\overline{\Delta}_2^* = [100, 100] - [63.33, 66.74] = [33.26, 36.67]$,
- $\overline{\Delta}_3^* = [100, 100] - [67.25, 70.27] = [29.73, 32.75]$,
- $\overline{\Delta}_4^* = [100, 100] - [62.57, 65.38] = [34.62, 37.43]$.

On the other hand, the results for $\overline{\overline{\Delta}}_j^*$ are as it is shown below:

- $\overline{\overline{\Delta}}_1^* = [100, 100] - [64.26, 67.78] = [32.22, 35.74]$,
- $\overline{\overline{\Delta}}_2^* = [100, 100] - [65.04, 69.25] = [30.75, 34.96]$,
- $\overline{\overline{\Delta}}_3^* = [100, 100] - [62.33, 64.32] = [35.68, 37.67]$,
- $\overline{\overline{\Delta}}_4^* = [100, 100] - [64.27, 66.64] = [33.36, 35.73]$..

As it is seen, the values always resulted in improvements of around 30% or more, both when the target group was compared with itself before and after passing the program, and when the target group was compared with the control group.

To obtain a result that encompasses all dimensions in a single final value, we will use formula 11:

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$$\min([a_1, b_1], [a_2, b_2]) = [\min(a_1, a_2), \min(b_1, b_2)] \quad (11)$$

In this case, $D^* = \min([66.33, 68.73], [63.33, 66.74], [67.25, 70.27], [62.57, 65.38]) = [62.57,65.38]$, it is the result for the target group before passing the program. After passing the program the general result is $[100, 100]$.

For the control group this is $\tilde{D}^* = \min([64.26, 67.78], [65.04, 69.25], [62.33, 64.32], [64.27, 66.64]) = [62.33,64.32]$. Finally, we obtained the results for the "Intercultural Attitude" test, before and after for the target group and the control group. These are shown in Figure 5:

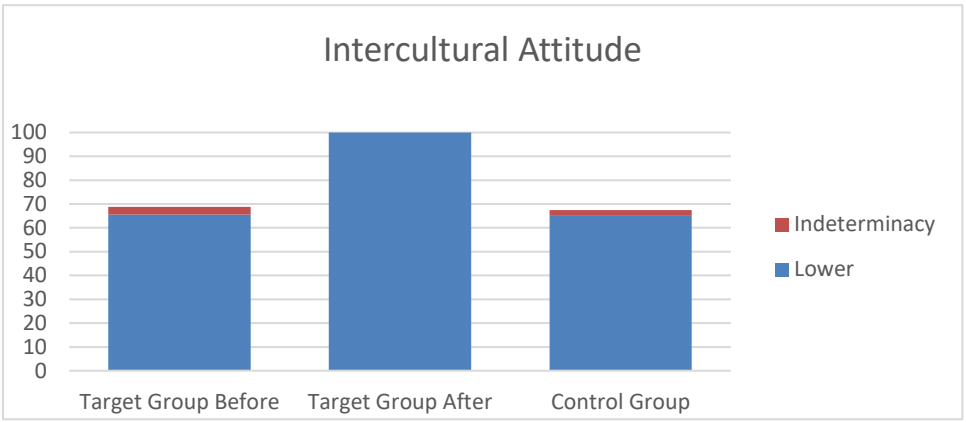

Figure 5: Average results of the Target Group before and after passing the program and of the Control Group for "Multicultural Attitude". In blue it is the determined percentage and in red it is the indeterminate percentage. In this case, let us calculate the difference in absolute value to avoid negative numbers in the calculation of the relationship between "Intercultural Attitude" and the results of the program. That is, Equation 12 is used.

$$[a_1, b_1] \ominus [a_2, b_2] = [\text{abs}(a_1 - b_2), \text{abs}(b_1 - a_2)] \quad (12)$$

In this case, it is:

$[65.54, 68.85] \ominus [65.02, 67.47] = [1.93, 3.83]$ which is the result of comparing "Intercultural Attitude" with the aggregation of the four dimensions representing "Cultural Identity". This means a difference less than 5% between both results.

On the other hand, $[100, 100] \ominus [100, 100] = [0, 0]$ for both variables after the program. This suggests a high and positive correlation between "Cultural Identity" and "Intercultural Attitude".

4. Conclusion

Both, cultural identity and intercultural attitude are two cultural components of people that are being lost in many countries due to cultural globalization. One of the Latin American countries with a great cultural heritage is Peru. In this article, we proposed to study the effectiveness of a cultural academic program carried out by 5th-year high school students of Educational Institution No. 35005 Reverend Father Bardo Bayerle of the Province of Oxapampa. We compared the results before and after a study group, and also between the results of the program after the target group passed this with a control group that did not pass the program. For this result, we used Plithogenic Statistics, specifically based on calculations between intervals. Among the relevant results, it is that both before and after passing the program, the difference between the measured variables, "Affective Communication", "Exchange of Knowledge and Experiences", "Social Coexistence" and "Consensus of Differences" representing "Cultural Identity", compared with "Intercultural Attitude" have a difference of no more than 4%, which indicates that there is a positive correlation between them. Therefore, we can conclude that cultural identity must be strengthened to promote respect for intercultural attitudes.

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