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VARIABLES FOR A DECISION MODEL OF EDUCATION AND VOCATIONAL GUIDANCE AT THE NATIONAL UNIVERSITY OF PILAR

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Abstract: This work is a proposal to identify the variables involved in the implementation of an AHP (Analytic Hierarchy Process) model for the decision making of future university students in choosing their university careers in the geographical area of influence of the city of Pilar. ; It was developed at the Faculty of Applied Sciences of the National University of Pilar (Republic of Paraguay) within the framework of the Master's Degree in Informatics and Computing. In order to identify the variables and establish criteria, the preferences of all the students of the last year of the following Institutions in the city of Pilar: Juan XXIII Subsidized Private Technical School, Santo Tomás Italian Private School and Pilar Regional Education Center. The options offered in the election are the courses taken at the National University of Pilar (UNP). The work methodology was based on quantitative methods and Tomás Saaty's Analytic Hierarchy Process (AHP) was used, which is a decision-making method applied in multi-agent and complex environments. The theoretical foundations of the method are presented and developed, from its beginnings with the preparation of the criteria preference matrix, the calculation of the normalized matrix and the calculation of the weighting vector; Comparison matrices by criteria are also developed with the corresponding calculation of the weights, to finally reveal the order of preferences established for the case, with the corresponding treatment of the criteria comparison matrix and the area comparison matrices. (alternatives) of each of the criteria, thus confirming the validity of the variables found. The results obtained are presented and future lines of research are formulated.

Keywords: Decision making; AHP model for choice; University orientation; University careers.

INTRODUCTION

This work presents the development of the model for choosing a university career. at the National University of Pilar through the multi-criteria decision method of the Hierarchical Analytical Process – AHP with variables (criteria) identified among students of the last year of the city of Pilar- Paraguay. We consider AHP a suitable model to resolve this type of situation.

The correct choice of a university career is a phenomenon that has been generating more and more inconveniences for some time; Students do not always consider all the variables involved in that decision and in this sense they do not attribute, in most cases, the correct weighting to each of them. The problem that this work addresses is the selection of variables, their weighting and classification for the application of a methodology for the correct choice of a university degree.

The UNP is not immune to the problems generated by student dropout due to the incorrect choice of university major, a problem in common with many other universities in the region and the world; In this sense, we assume that with this AHP model the institution could benefit by eventually reducing the impact of this problem. For the application and use of the AHP model in choosing a university career, it is necessary to analyze the problem in order to recognize the details and difficulties that arise in this decision making and also as a support that favors us and that can generate data that allows designing policies and executing actions that contribute to avoiding or at least reducing student dropout. The implementation of this model will contribute to providing information so that students can choose their vocational orientation in better conditions and remain in the university higher education system, thus achieving the objective of graduating in the chosen career.

In this work, a search has been carried out for background information related to i) Studies on repetition and dropout in higher education at the UNP; ii) Causes of students dropping out of their university studies; iii) Choice of a professional career; iv) Vocational guidance; v) Use of the Analytical-Hierarchical Process of Thomás L. Saaty (AHP). Between the statistical data for the period 2015 – 2019 studied. No antecedents have been found that simultaneously address sections i), ii) and iii) mentioned above, which is why it is considered that this work meets the conditions of originality and academic relevance.

Based on some studies that explain desertion and disintegration in other Universities in the region such as they mention (Acosta & La Red Martínez, 2020), (Acosta *et al.*, 2012); we have been able or identify some variables that we assume may be the most incidental in our case, such as :the influence of the student's socio-economic level on the choice of university major, the modality of course of the courses, the prestige of the higher education institution, the geographical distance between the place of origin of the student and the chosen study center, the level of prior knowledge related to the discipline.

STATE OF THE ART

Regarding the choice of a professional career, repetition and dropping out of university studies, we find the following antecedents:

In Smulders Chaparro (2018) says that the "most relevant factors that determine dropping out of studies are internal and external. External factors: he confirms that the economic situation is an important influence on desertion. Internal factors: temperamental differences, cases of pregnancy and accumulation of deferments." (p. 5).

The Ministry of Education and Culture of the Republic of Paraguay (2010) states that "school dropout is the process of gradual withdrawal from school that culminates in the child or adolescent dropping out.". (page 13).

Thompson (2017) states that"Not only is dropout a determining factor for students not completing their studies, there is also another factor such as the need to work. "It maximizes the potential of students and favors the rapid insertion of the student into the world of work." (p. 108).

Vélez, López & López Jiménez (2004), mention that lhe dropout factors in Argentina are: "the quality of information, economic factors, vocational orientation and academic performance" (Ministry of National Education, 1994, 27). (p. 180).

In other countries such as Chile, education is perceived as the main means to ascend socially, since obtaining a university degree ensures a good salary in the professional career of those who complete their university studies; In this sense, Vélez, López & López Jiménez (2004) say that: the "phenomenon of student dropout is seen as a threat to the efficiency of the fiscal contribution to education, and is seen as the main responsible for financing problems." for places for future students." (p. 180).

Regarding vocational guidance we know that:

For Adur and Esteban (2018), "the decision-making process begins within the family, with the models and expectations of the parents and continues with the acquisition of the educational experiences that make up the personal learning history of each student.". (p. 184).

In reference to the technique that we understand to be appropriate for this work called Analytical-Hierarchical Process (AHP), we find that:

For Gimon Polo (2018): "The AHP method has many applications. The most common ones take place in the business world with personnel selection, supplier selection, situation to open a new agency/workplace." (p. 7).

In Escrivá (2015)It is said that: "the decision-making process will be carried out through the AHP, it is one of the multi-criteria decision methods that best solves complex multi-criteria problems, developed by Thomas L. Saaty (The Analytic Hierarchy Process 1980)". (p. 5).

According to Moreno J., Altuzarra C., and Escobar U. (2003), the Hierarchical Analysis Process – AHP – and a Multicriteria decision technique proposed by TL Saaty (1977) (1980), which combines tangible and intangible aspects to obtain, on a ratio scale, the priorities associated with the alternatives of the problem that is useful in the plan, selection of alternatives, resource placement and conflict solutions as well as optimizations.

According to Toskano Hurtado (2005), the AHP method "developed by Tomas L. Saaty is designed to solve complex multi-criteria problems, thus obtaining a hierarchy with priorities that sample the decision for an alternative." (p. 23).

Decision making is a complex process that finds its foundations in a multidisciplinary intersection of knowledge. Disciplines such as sociology, psychology, economics and others provide valuable perspectives from their particular approaches.

According to Moreno J., Altuzarra C., and Escobar U. (2003) AHP has three stages: "modelling, assessment and prioritization". (p.4).

MATERIALS AND METHODS

Taking into account the object-problem-objectives triad, we consider that the problem defines the objectives and the objectives of the research determine the object of the study, we identify as the object of study in this work the cohort of students analyzed with the preferences and choices of each of the students.

Likewise, each of them are also objects of study in this work to respond to the problem of determining whether the implementation of the aforementioned method is possible and then, if so, implementing it, achieving the objective, which is to finally confirm that the selection of the variables involved in the choice of the career to establish an order of evaluation between possible career alternatives to be chosen by the students has been correct, thus confirming our working hypothesis: "if we correctly select the variables involved in the choice of the careers to be followed by the students, using the AHP method it will be possible to establish an appropriate order of priorities in the election." The collection and interpretation strategy used has been mainly quantitative, with quantitative weighting of the variables.

The objects of study in this work have been the students of the last year of the Juan XXIII Private Subsidized Technical Schools, the Italian San Tomás Schools and the Pilar Regional Education Center, all of the city of Pilar, among whom we have investigated their preferences and academic situations. and socioeconomic in correlation with the possible careers to follow in order to analyze the variables involved in their decisions to establish priorities and thus prepare the preference matrix.

Specific objectives have been set:

- Determine if the student's socio-economic level influences the choice of a university degree and if this constitutes a variable or sub variable in the AHP Method;

- Determine if the course modality of the University's courses has an impact on the choice of the university major, and if this constitutes a variable and sub variable of the AHP method;

- Determine the relevance of the perception of the prestige of the Higher

Education Institution in the choice of university major;

- Determine if geographical distance influences the choice of university major;

- Check if the result of the vocational test influences the choice of university major;

- Determine if prior knowledge influences the choice of university major.

METHODOLOGY

Our methodology determined as objects of analysis the entire universe of study that is made up of the students mentioned above, who are objects of this study. At the anchor level of the data matrix of this work, in the terms of Samaja (1996), the unit of analysis was constituted with each of the students from the selected schools in the aspects necessary to determine the variables that influence in the choice of university major; At the sublevel of the data matrix the units of analysis have been the detected variables and at the supralevel, the unit of analysis is the model conceived for the study and analysis of the selection of a university degree.

From the data obtained, it has been determined that certain independent variables have little or almost no participation in the explanation of the behavior of the dependent variable, such as the result of the conclusions of the vocational test; thus, achieving a simpler model adjusted to observable and measurable reality. This was complemented with interviews and/or online questionnaires with students in the last year of secondary education regarding what criteria they consider relevant for choosing their university majors. In addition, similar surveys were carried out on university students to investigate the reasons that led them to choose the degree they are studying and whether their expectations have been met. After the criteria were selected, the hierarchy of the AHP model was defined, proposing the structures that have been evaluated and then validated in order to define the final structure that was used.

To establish the possible options, information was collected provided by the UNP regarding the careers offered. Surveys were also carried out on university students to investigate the reasons that led them to choose the career they are studying and if their expectations have been met.

After selecting the criteria, the hierarchy of the AHP model was defined, proposing various structures that have been evaluated and validated to then define the final structure that has been used.

THE "HIERARCHICAL ANALYSIS PROCESS" METHOD - AHP

The mathematician Thomas L. Saaty proposed the method called Hierarchical Analysis Process, it is a method for decision making applied in multi-agent and complex environments, which provides the user who will make the decision, through the construction of a hierarchical model, the possibility of structuring a problem and then choosing the most convenient option.

The Hierarchical Analysis Process – AHP, according to Toskano Hurtado, (2005), "is designed to solve complex multi-criteria problems, thus obtaining a hierarchy with priorities that show the decision for an alternative" (p. 23).

For Gimon Polo, (2018): "The AHP method has many applications. The most common ones take place in the business world with the selection of personnel, selection of suppliers, situation to open a new agency / workplace" (p. 7).

The AHP has a scale that measures judgments created by TL Saaty himself.

1.0	Both elements are of equal importance	Both elements contribute to the property in the same way.
3.0	Moderate importance of one element over another.	Experience and judgment favor one element over the other.
5.0	Strong importance of one element over another.	One element is strongly favored.
7.0	Very strong, importance of one element over another.	One element is very strongly dominant.
9.0	Extreme importance of one element over another.	One element is favored, at least with an order of magnitude difference.
2.0, 4.0, 6.0, 8.0	Intermediate values between two adjacent judgments	Used as consensus values between two judgments.
Increments of 0.1	Intermediate values at the finest graduation of 0.1 (For example 5.2 is a valid entry).	Used for finer gradations of judgments

It is a quantitative method that generates priority scales based on expert judgments revealed through pairwise comparisons using a preference scale; These scales allow judgments about intangibles to be incorporated into a decision model, representing the preference of one alternative over another in relation to an attribute (Nantes, 2019).

The appeal of the AHP lies in the fact that it does not require a common scale of measurements of all factors, it begins by determining the relative importance of the criteria and compares the weight of the criteria in pairs. It deals exclusively with ordered pairs of priorities according to the importance, preference or probability of pairs of elements based on a common criterion that represents the decision hierarchy. With this method, group decision-making is carried out by aggregating opinions, in such a way that it meets expectations when comparing the elements.

There are five characteristics or elements in decision making:

- The goals: They are the things you want to achieve, expressed in terms of specific states in time and space;
- The objectives: They are the reflections of desires that indicate the direction in which we should work;
- The criteria: are the standards of judgment or rules that validate the acceptability of the decision;
- The alternatives: They are the possible decisions that favor the achievement of the established goals;
- The attributes: They are the characteristics, qualities or performance parameters of the alternatives to be considered to make the decision.

Once the criteria are established, comparisons are made between criteria, determining the importance of each one of them over the others; The comparison matrix is thus created, designing a standard that takes into account which criterion is preferable over the others. In AHP, decision making is facilitated with verifications and/or subjective evaluations of the fundamentals of each of the criteria, to then define the priorities for the choice of decision alternatives and for each criterion.

Through the AHP, quantitative data related to decision alternatives is included; with the possibility of incorporating qualitative data (criteria) that often offer a certain level of complexity to be measured and are outside of this study, in these cases with relative analysis the linguistic values can be transformed into numerical values.

Through the construction of the hierarchical model, all the information regarding the problem is organized in an efficient and graphic way, decomposed and in this way studied by parts; and based on the established preference relationships of the criteria among themselves and the alternatives with respect to each criterion, the result is finally established, which is the sought vector of priorities.

Once the criteria that affect the choice or the determination of the priority scale of the alternatives to be chosen have been determined, we form the comparison matrix with values assigned to each of the pairs ordered according to rows and columns, taking into account each one of the pairs ordered the importance or preference of elements according to the row and column order of the corresponding criteria.The AHP method allows giving numerical values to the judgments given by the experts, and thus measures how each element contributes to the decision making.

The work begins by forming an ordered set X of criteria,

$$X = \{x_1, x_2, \dots, x_n\} \quad (1)$$

One way to determine a weighted order is to propose a relationship

$$R: (x_i, x_j) \in X \times X \rightarrow a_{ij} \in [a_{ij}]^{n \times n} \quad (2)$$

Matrix *A* is the comparison matrix between pairs, in which a_{ij} it expresses the extent to which x_i it is preferred with respect to x_j, with an assumed reciprocity condition, so that the preference of x_i over x_j is expressed by a_{ij}; and reciprocally the preference of x_j over x_i is expressed by a_{ji}. So, under certain conditions of consistency, the whole *X* is totally ordered by the relation *R* and there exists a vector *ω* which perfectly represents the preferences on *X* .

where:

$$A = \begin{bmatrix} a_{11} & a_{12} & \cdots & a_{1n} \\ a_{21} & a_{22} & \cdots & a_{2n} \\ \dots & \dots & \dots & \dots \\ a_{n1} & a_{n2} & \cdots & a_{nn} \end{bmatrix} \quad (3)$$

The conditions of reciprocity and consistency depend on the different meanings given to the number a_{ij}, since there are several types of pairwise comparison matrices as mentioned below (Cavallo & D'Apuzzo 2014).

First of all we have the condition of reciprocal judgments, "if against a criterion, an alternative x_i is *n* times better than x_j, then x_j is 1/*n* times better than x_i. This principle is one of those used in the matrix analysis that is carried out on the criteria and alternatives.(Osorio Gómez & Orejuela Cabrera, 2008; p. 249).

When the reason for the preference of $a_{ij}>0$ about x_i x_j then the reciprocity condition is given by:

$$a_{ji} = \frac{1}{a_{ij}} \qquad \forall i, j = 1, \dots, n \quad (4)$$

and the consistency condition is given by:

$$a_{ik} = a_{ij} \cdot a_{jk} \qquad \forall i, j, k = 1, \dots, n \quad (5)$$

The matrix of elements obtained from formula (4) is known as the multiplicative reciprocity matrix, while formula (5) determines the multiplicative consistency.

Then the matrix A(3) is said to be consistent if and only if there exists a vector $w= (w_1,w_2,\dots,w_n)$ which checks the condition $\frac{w_i}{w_j} = a_{ij}$.

If a_{ij} represents the difference in preference between x_i and x_j the reciprocity condition is given by:

$$a_{ji} = -a_{ij} \qquad \forall i, j = 1, \dots, n \quad (6)$$

and the consistency condition is given by:

$$a_{ik} = a_{ij} + a_{jk} \qquad \forall i, j, k = 1, \dots, n \quad (7)$$

In this case, the matrix of elements obtained from the formula(6) is called the additive reciprocity matrix and (7) determines the additive consistency. Then the matrix A is consistent if and only if there exists a vector $w=(w_1,w_2,\dots,w_n)$ that verifies the condition w_i-w_i= a_{ji}

There are also fuzzy pairwise comparison matrices and interval pairwise comparison matrices; are Matrices represent an extension of traditional pairwise comparison techniques. In this work, the multiplicative (or reciprocal) pairwise comparison matrix model was used.

To summarize the judgments

1. Once the comparison matrix *A* is determined, we add the values in each column of the paired comparisons matrix.

$$c_j = \sum_{i=1}^{n} a_{ij} \quad 1 \leq j \leq n \tag{8}$$

2. We divide each component of the previous matrix by the sum located in the last row and thus obtain the *normalized matrix*.

$$N = \begin{bmatrix} n_{11} & n_{12} & \cdots & n_{1n} \\ n_{21} & n_{22} & \cdots & n_{2n} \\ \cdots & \cdots & \cdots & \cdots \\ n_{n1} & n_{n2} & \cdots & n_{nn} \end{bmatrix} \tag{9}$$

where:

$$n_{ij} = \frac{a_{ij}}{c_j} \tag{10}$$

3. We estimate the vector of priorities or weights (weighting), thus calculating the average of the elements of each row of the normalized matrix.

Thus we will have the vector $w=(w_1,w_2,\ldots,w_n)$ where:

$$w_i = \frac{\sum_{j=1}^{n} n_{ij}}{n} \qquad 1 \leq i \leq n \tag{11}$$

The values resulting from formula (11) determine the weighting vector.

4. We measure the consistency of the comparison matrix: to measure the consistency of the comparison matrix, the comparison matrix itself is multiplied *TO* by the weighting vector *W*; so we have:

$$A^{(n\times n)} \times W^{(n\times 1)} = P^{(n\times 1)} \tag{12}$$

For Nantes, (2019) the judgments reflected in each matrix must be consistent with each other, this is to respect certain entirely reasonable properties; i) Transitivity implies that the order must be respected when comparing more than two elements. If A is better than B and B is better than C, then A is better than C. ii) Proportionality implies that in addition to transitivity, judgments must be related in terms of orders of magnitude. That is, if A is 2 times larger than B, and B is 3 times larger than C, then A must be 5 times larger than C. A matrix is entirely consistent when transitivity and proportionality are satisfied in judgments. However, it is common to find some level of inconsistency in complex matrices. The AHP method measures the global inconsistency for each matrix based on the ratio of the matrix inconsistency and a random consistency index that depends on the size of each matrix. A ratio no greater than 0.10 is considered acceptable to continue with the decision process. Otherwise, the ratings should be reviewed before continuing. (Nantes, 2019; p. 61).

If the matrix is consistent, it must be verified that:

$$A \cdot w = \lambda \cdot w \tag{13}$$

where A is the comparison matrix, if the priorities or weights were known w is the priority vector and the lambda λ is a scalar.

If the judgments are coherent, then matrix A would have a single eigenvalue $\lambda = n$; that is, equal to the numberof compared elements.

Generally it is not possible for human judgments to be perfectly consistent, there will always be inconsistency - to some extent at least -; The important thing is that it does not exceed admissible limits, what has been said implies that the comparison matrix will have more than one own value; The maximum eigenvalue allows us to estimate the degree of consistency of the comparison matrix through the consistency index; To verify if the degree of consistency is admissible, a random consistency index obtained by simulation is used as a reference.

If the consistency index (IC) is equal to zero it means that the consistency is complete, as this measure depends on the order of the matrix (n), Saaty proposes the use of the consistency ratio (RC) that is obtained by dividing the CI by its expected value, the random index (IA), calculated from a large number of randomly generated reciprocal matrices of order n (Table 1).

$$IC = \frac{\lambda_{max} - n}{n-1} \quad (14)$$

where λ_{max} is the sum of the elements of the vector that results from multiplying the comparison matrix A by the weight vector P

Therefore, the matrix is consistent if the RC value does not exceed the values indicated in Table 2. If the maximum RC is exceeded in a matrix, the weights must be reviewed.(Yepes, 2022).

The consistency ratio (RC) measures the degree of inconsistency of the varied comparison matrix and is calculated as the quotient between the consistency index (IC) and the randomness index (IA).

If the consistency ratio is equal to 0 the matrix is consistent RC = 0 is Consistent; with RC < 0.10 the matrix has admissible inconsistency, which means that for the purposes of the work it can be considered that we are in good conditions of consistency and the vector of weights obtained is admitted as valid; If the CR > 0.10, the inconsistency is unacceptable.

Matrix size (n)	Consistency ratio
3	5%
4	9%
5 or greater	10%

Table 2

It is important that comparisons are consistent so that the results of the AHP method are reliable. If the inconsistency index is high, it may indicate that the expert's stated preferences are inconsistent and should be revised. Once the consistency is verified, the weights are obtained, which represent the relative importance of each criterion or the priorities of the different alternatives with respect to a certain criterion.(Yepes, 2022).

APPLICATION OF AHP TO A WITNESS CASE

The first step in the application of the AHP has been to determine the criteria that will make up the preferences matrix, and these are precisely the variables that we are looking for in our work, for which we have carried out previous work through forms in online Google format. , a task that was authorized by the authorities of the Schools involved in this study and which consisted of a data survey of the students of the last year of the aforementioned establishments.

In the information collection, 278 (two hundred and seventy-eight) students out of a total of 282 (two hundred and eighty-two) students answered the survey. The survey was aimed at knowing the different variables that affect the students' decision-making preferences, seeking to know the current and particular local reality.

The information gathering survey focused on aspects such as the academic situation of the respondents. , which inquiries about the orientation with which they will graduate from the secondary education level, it is asked if the student has ever been failed in a final exam and how many evaluations they took to obtain the final grade, taking into account that there are 3 (three) opportunities that the student has to take and complete their studies, they are: ordinary, complementary, extraordinary exam. Aspects related to the student's family situation are addressed, which contains aspects that can influence the choice of university major, such as: the gender to which the student belongs; marital status is also investigated, including whether or not the student has children; Assuming that the diversity of personal situations could impact academic and professional decision-making, information is also collected about the number of siblings of the student, which allows a better understanding of the individual's family

Matrix size (n)	2	3	4	5	6	7	8	9	10
Random index (AI)	0	0.58	0.9	1.12	1.24	1.32	1.41	1.45	1.49

Table 1

environment. We also investigate the student's employment situation, providing options such as: they have a job, are unemployed or looking for work activity; those who dedicate themselves exclusively to study, and those who combine work and studies; the condition of the student's housing is also investigated, which is another indicator that affects the determination of the student's socioeconomic situation, in particular, whether he or she resides in his or her own home, rents or lives in the residence of a family member or friend, in addition. Additional variables are examined such as the availability of an Internet connection and the possession of mobile data for cell phones at home.

Another aspect to consider is the diversity of academic offerings available in the different faculties of the UNP. Students are offered the opportunity to choose three careers of their choice in order of priority. This choice not only reflects the individual interests and career aspirations of each student, but also provides valuable information to guide educational planning efforts and the design of academic programs tailored to the needs and demands of students.

Yepes, (2018) says that: it is important that the number of criteria and sub-criteria at each level is not greater than 7, to avoid excessive pairwise comparisons; which would cause matrices to be configured whose consistency is not recommended or inconsistent. The experts will also determine which comparison matrix will be used; In our case we have chosen to use the reciprocal comparison matrix.-

The variables identified as incidents in the students' choice have been considered as criteria for the formation of the preference matrix; In this case there have been 5 (five): a) Affinity of the chosen career with the degree obtained in secondary level studies, b) Ease of entry to the chosen career, c) the Prestige of the chosen Faculty, d) Employment situation of the student, e) Distance to travel to the chosen Faculty. Once the criteria were identified, we proceeded to establish the levels of preferences among them, taking care that the responses obtained in the surveys are reflected in them and analyzing the reasonableness of the established preferences.

Taking into consideration, the values recorded in the Saaty Scale in the Comparison Matrix (Table 3), the Affinity of the chosen career with the degree obtained in secondary level studies was prioritized over the Prestige of the Faculty chosen with a rating of 5; The Ease of entry to the chosen career based on the Affinity of the chosen career with the degree obtained in secondary level studies with qualification 2; the Ease of entry to the chosen career based on the Prestige of the chosen Faculty with a rating of 5; the student's employment situation regarding the affinity of the chosen career with the degree obtained in intermediate level studies with a grade of 3; the student's employment status based on the Prestige of the chosen Faculty with a rating of 3; the student's employment situation regarding the ease of entry into the chosen career with a rating of 2; The distance of transfer to the chosen Faculty based on the Affinity of the chosen career with the degree obtained in intermediate level studies with a grade of 3;

The distance of transfer to the chosen Faculty based on the Prestige of the chosen Faculty with a rating of 5; the Distance of transfer to the chosen Faculty on the Ease of entry to the chosen career with a rating of 2; the Distance of transfer to the chosen Faculty on the Employment Situation of the student

Criteria	Criteria					Normalized matrix					Weighing
	Affinity of the chosen career	Ease of entry to the chosen Faculty	Prestige of the chosen Faculty	Student's Employment Status	Travel distance to the Faculty						
Affinity of the chosen career	1	5	1/2	1/3	1/3	0.11	0.26	0.09	0.08	0.13	0.13
Ease of entry to the chosen Faculty	1/5	1	1/5	1/3	1/5	0.02	0.05	0.03	0.08	0.08	0.05
Prestige of the chosen Faculty	2	5	1	1/2	1/2	0.22	0.26	0.18	0.12	0.20	0.19
Student's Employment Status	3	3	2	1	1/2	0.33	0.16	0.35	0.24	0.20	0.25
Travel distance to the Faculty	3	5	2	2	1	0.33	0.26	0.35	0.48	0.39	0.36
Total	9.20	19.0	5.70	4.17	2.53						

Table 3

with a grade of 2. In the main diagonal of the comparison matrix, the comparison of each of the criteria with itself is represented, a comparison to which a value of 1 is naturally assigned. because each criterion cannot be preferred (or discarded) to itself.

In our case, the vector of weights obtained indicates that: the travel distance to the Faculty, which has a weight of 0.36, is more important than the student's Employment Status, which has a weight of 0.25.

Likewise, the student's Employment Situation with its weight of 0.25 is more important for the student in choosing a career than the Prestige of the chosen Faculty, which has a weight of 0.19; the Prestige of the Faculty chosen was more important in the election than Affinity of the chosen Career, which was weighted with a value of 0.13 and finally the Affinity of the chosen Career with its 0.13 weighting resulted with more weight in the decision than Ease of entry to the Faculty chosen that obtained a weighting of 0.05.

Now it is necessary to verify the consistency of the comparison matrix adopted, for this we calculate the consistency ratio; We multiply the comparison matrix A by the weights vector P and then we add the elements of the vector resulting from that operation, thus having the value of n_{max}; With that value we calculate the consistency index of A (IC) using the formula:

$$IC = (n_{max} - n)/n - 1 = 0{,}045 \quad (15)$$

where n is the number of criteria. We then calculated the random consistency index (AI); This index can be tabulated based on the number of weighted criteria as stated in chapter 3 or it can be calculated using the formula:

$$IA = \frac{1.98 \cdot (n-2)}{n} = 1{,}188 \quad (16)$$

and with these two values the consistency ratio (RC) is found by taking the quotient between the consistency index of matrix A (IC) and the random consistency index (IA)

$$RC = \frac{IC}{IA} = 0{,}038 \text{ CR} < 0.1 \text{ BC} \quad (17)$$

The *RC* = 0.038, less than 0.1, indicates that we are in good conditions of consistency in the matrix.

Each of the preferences is analyzed below according to the faculties potentially chosen for each of the criteria: a) the Affinity of the chosen Career, b)Ease of entry to the chosen Faculty, c) Prestige of the chosen Faculty, d) Student's Employment Status and e)Travel distance to the Faculty; the different areas where the possible careers to be chosen are located: i) Faculty of Biomedical Sciences: Health (Bachelor in Nursing); ii) Faculty of Applied Sciences: Applied Sciences (Bachelor in Systems Analysis, Industrial Engineering, Environmental Engineering, Bachelor in Physical Education and Sports Training); iii) Faculty of Accounting, Administrative and Economic Sciences: Economic Sciences (National Public Accounting and Bachelor of Business Administration); iv) Faculty of Humanities and Educational Sciences: Humanities (Bachelor in Educational Sciences, Labor Psychology, Bachelor in Mathematics and Bachelor in Psychology with Educational Orientation); v) Faculty of Law, Political and Social Sciences: Law (Law, Bachelor of Political Science, Bachelor of Social Work and Notaries).The respective comparison matrices are thus formed for each of the criteria (Tables 4 to 8); and with each of them the normalized matrices are calculated. Finally, the vector of the weights for the criterion treated in each case is obtained, with the methods and developments described above (Table 9). In each case we verify that the consistency index is acceptable according to the exposed parameters.

According to the Hierarchical Analysis Method, in particular the order of priorities for choosing a university major will be:

1) Bachelor's Degree in National Public Accounting or Bachelor's Degree in Business Administration, which belong to the area of Economic Sciences.

2) Law or Bachelor's Degree in Political Science or Bachelor's Degree in Social Work or Notaries that belong to the area of Law.

3) Bachelor's degree in Nursing that belongs to the Health area.

4) Bachelor's Degree in Educational Sciences or Bachelor's Degree in Mathematics or Bachelor's Degree in Labor Psychology or Bachelor's Degree in Psychology with Educational Orientation that belong to the area of Humanities.

5) Bachelor's Degree in Systems Analysis or Bachelor's Degree in Physical Education and Sports Training or Industrial Engineering or Environmental Engineering that belong to the area of Applied Sciences.

RESULTS AND CONCLUSIONS

DISCUSSION AND ANALYSIS OF RESULTS

In collecting information to establish the choice alternatives, we found that when considering each of the possible careers to be chosen, we would have 16 careers in the different faculties.

There is a significant number of alternatives. In the case of the criteria to be considered in the election, these were chosen based on what was expressed by the students surveyed. In the choice of criteria to be considered, attention was paid to ensuring that the selected criteria were those that appeared most frequently in the responses. and that they also cover other criteria mentioned in the surveys but that, due to the lower frequency with which they were mentioned, have not been selected; 5 (five) criteria were selected since the method recommends working as much as possible with 7 (seven) or fewer criteria alternatives.

We have grouped the 16 (sixteen) alternatives into 5 (five) areas based on the faculties to which each of the careers that could be an option for the students belong.

The reciprocal comparison matrix was thus formed according to the scale proposed by Saaty, verifying that always if $C1 < C2 < C3 < C4 < C5$; or if $C4 < C3 < C1 < C2 < C5$ or if $C5 < C2 < C1 < C4 < C3$, for example, in no case do the recorded values show a different reasoning; If that had happened, it would be the reason for the introduction of some inconsistency.

Area	Criterion: Affinity of the...					Normalized Matrix					Weighing
	Health	Applied	Cs. Economic	Humanities	Right						
Health	1	5	1/4	1/2	2	0.13	0.23	0.12	0.13	0.12	0.15
Cs. Applied	1/5	1	1/6	1/7	1/3	0.03	0.05	0.08	0.04	0.02	0.04
Cs. Econ.	4	6	1	2	6	0.52	0.27	0.48	0.53	0.35	0.43
Humanities	2	7	1/2	1	8	0.26	0.32	0.24	0.27	0.46	0.31
Right	1/2	3	1/6	1/8	1	0.06	0.14	0.08	0.03	0.06	0.07
TOTAL	7.70	22.0	2.08	3.77	17.3						

$$IC = (5{,}38 - 5)/(5 - 1) = 0{,}10$$

$$IA = \frac{1{,}98 \cdot (5 - 2)}{5} = 1{,}188$$

$$RC = \frac{0{,}10}{1{,}188} = 0{,}08 \qquad CR < 0.1\ BC$$

Table 4. Comparison matrix for the criterion Affinity of the chosen career

Area	Criterion: Ease of Entry…					Normalized Matrix					Weighing
	Health	Applied	Cs. Economic	Humanities	Right						
Health	1	8	1/3	6	2	0.21	0.33	0.19	0.36	0.23	0.26
Applied	1/8	1	1/9	1/2	1/4	0.03	0.04	0.06	0.03	0.03	0.04
Cs. Economic	3	9	1	7	5	0.63	0.38	0.56	0.42	0.57	0.51
Humanities	1/6	2	1/7	1	1/2	0.03	0.08	0.08	0.06	0.06	0.06
Right	1/2	4	1/5	2	1	0.10	0.17	0.11	0.12	0.11	0.12
TOTAL	4.79	24.0	1.79	17	8.75						

$$IC = (5{,}21 - 5)/(5 - 1) = 0{,}05$$

$$IA = \frac{1.98 \cdot (5 - 2)}{5} = 1{,}188$$

$$RC = \frac{0{,}05}{1{,}188} = 0{,}04 \qquad CR < 0.1\ BC$$

Table 5. Comparison matrix for the criterion: Ease of entry to the chosen Faculty.

Area	Criterion: Prestige of the Faculty					Normalized Matrix					Weighing
	Health	Applied	Cs. Economic	Humanities	Right						
Health	1	7	2	1/2	4	0.26	0.30	0.26	0.24	0.30	0.27
Applied	1/7	1	1/5	1/8	1/2	0.04	0.04	0.03	0.06	0.04	0.04
Cs. Economic	1/2	5	1	1/4	2	0.13	0.22	0.13	0.12	0.15	0.15
Humanities	2	8	4	1	6	0.51	0.35	0.52	0.49	0.44	0.46
Right	1/4	2	1/2	1/6	1	0.06	0.09	0.06	0.08	0.07	0.07
TOTAL	3.89	23.0	7.70	2.04	13.5						

$$IC = (5{,}10 - 5)/(5 - 1) = 0{,}025$$

$$IA = \frac{1{,}98 \cdot (5 - 2)}{5} = 1{,}188$$

$$RC = \frac{0{,}025}{1{,}188} = 0{,}02 \qquad \text{CR} < 0.1 \text{ BC}$$

Table 6. Matrix comparison for the criterion: Prestige of the chosen Faculty.

Area	Criterion: Employment Status…					Normalized Matrix					Weighing
	Health	Applied	Cs. Economic	Humanities	Right						
Health	1	5	1/5	1/2	2	0.11	0.23	0.11	0.10	0.14	0.14
Applied	1/5	1	1/8	1/6	1/2	0.02	0.05	0.07	0.03	0.03	0.04
Cs. Economic	5	8	1	3	6	0.57	0.36	0.55	0.62	0.41	0.50
Humanities	2	6	1/3	1	5	0.23	0.27	0.18	0.21	0.34	0.25
Right	1/2	2	1/6	1/5	1	0.06	0.09	0.09	0.04	0.07	0.07
TOTAL	8.70	22.0	1.83	4.87	14.5						

$$IC = (5{,}25 - 5)/(5 - 1) = 0{,}06$$

$$IA = \frac{1{,}98 \cdot (5 - 2)}{5} = 1{,}188$$

$$RC = \frac{0{,}06}{1{,}188} = 0.05 \qquad \text{CR} < 0.1 \text{ BC}$$

Table 7. Matrix comparison for the criterion: Student's Employment Status.

Area	Criterion: Travel distance…					Normalized Matrix					Weighing
	Health	Applied	Cs. Economic	Humanities	Right						
Health	1	3	5	6	1/2	0.27	0.31	0.32	0.26	0.26	0.28
Applied	1/3	1	2	5	1/5	0.09	0.10	0.13	0.22	0.10	0.13
Cs. Economic	1/5	1/2	1	2	1/7	0.05	0.05	0.06	0.09	0.07	0.07
Humanities	1/6	1/5	1/2	1	1/9	0.05	0.02	0.03	0.04	0.06	0.04
Right	2	5	7	9	1	0.54	0.52	0.45	0.39	0.51	0.48
TOTAL	3.70	9.70	15.5	23	1.95						

$$IC = (5{,}17 - 5)/(5 - 1) = 0{,}04$$

$$IA = \frac{1{,}98 \cdot (5 - 2)}{5} = 1{,}188$$

$$RC = \frac{0{,}04}{1{,}188} = 0{,}03 \qquad \text{CR} < 0.1 \text{ BC}$$

Table 8 Comparison matrix for the criterion: Travel distance to the Faculty.

Area	Criteria					Prioritization
	Affinity of the chosen career	Ease of entry to the chosen Faculty	The prestige of the chosen Faculty	Student's Employment Status	Travel distance to the Faculty	
Health	0.22	0.27	0.24	0.20	0.34	0.2206
Applied	0.03	0.22	0.09	0.13	0.13	0.0716
Cs. Economic	0.36	0.18	0.22	0.22	0.12	0.2594
Humanities	0.26	0.15	0.13	0.16	0.20	0.2074
Right	0.14	0.18	0.32	0.30	0.21	0.2210
Weighing	0.13	0.05	0.19	0.25	0.36	

Table 9 Comparison Matrix of criteria and areas.

Another aspect to consider maintaining the consistency of the matrix is that if, for example, it happens that C1 < C2 < C3 < C4 < C5, it indicates that criterion 1 is the least preferred, and that criterion 3 is in the middle of the scale. of preferences, so to speak, and criterion 5 is the most valued; so, we take care that the difference in qualification between C1 and C3 is half or approximately half of the difference in the qualification between C1 and C5.

In our case we have always found acceptable values of the consistency relationship of the matrices involved, both for the criterion comparison matrix and for the area preference matrices by criteria.

It was possible to verify that the selected criteria have been correct for the selection of preferences among the 5 (five) proposed areas with subsequent surveys of students who established their criteria preferences identical or similar to the one proposed in the respective comparison and preference matrices. criteria.

From the values in Table 9 it turned out that the vector of preferences by areas was as follows: Health 0.2206; Applied 0.0716; Cs. Economic 0.2594; Humanities 0.2074 and Law 0.2210; values of which it is observed that: clearly the preferred area in the election is Cs. Economical with 0.2594; then the difference between Health and Law is barely -0.0004, which tells us about a virtual tie in preference that could be defined by considering the weights of the criteria that the interested party marks as priority (eliminating some of them in the matrix of the table 9); Then we observe that Humanities is assigned a clear fourth place in preferences with 0.2074 and Applied is very far behind with 0.0716.

CONCLUSIONS

In this work called: "Decision model for education and vocational guidance" the proposed objectives have been achieved; It has been possible to implement the AHP Method (Analytic Hierarchy Process) in the choice of the university degree to follow at UNP for the students of the study group made up of students from the aforementioned institutions; based on the identification of the variables involved in the decision and that have been presented as selection criteria in the weighting matrix.

Thus, responding to our hypothesis "if we correctly select the variables involved in the choice of careers to be followed by students, using the AHP method it will be possible to establish an appropriate order of priorities in the choice."

The previous data collection It allowed us to know the different options available and establish an order between them; Through this methodological approach, it was possible to effectively understand and prioritize the factors that influence decision-making related to the choice of university majors; thus, providing a solid basis to understand and improve the vocational guidance process of students in these educational institutions.

In this sense we have been able to:

- Determine that the variable socio-economic level (employment status) of the student influences the choice of university major and it has been incorporated as a criterion in the weighting matrix for the application of the AHP method.

- Determine that the course modality of the University courses is not incident in the choice of the university course, consequently this variable was excluded from the application of the AHP method.

- Determine that the prestige of the Higher Education Institution influences the choice of university major, and it has been incorporated as a criterion in the weighting matrix for the application of the AHP method.

- Determine that the geographical distance to the study center influences the choice of university major and it has been incorporated as a criterion in the weighting matrix for the application of the AHP method.

- Verify that the result of the Vocational Test is not decisive in the choice of a university career, consequently this variable was excluded from the application of the AHP method.

- Determine that prior knowledge (affinity of the chosen major) influences the choice of the university major and it has been incorporated as a criterion in the weighting matrix for the application of the AHP method.

The ease of entry to the faculty has also been revealed as an incident variable when choosing a career, so this variable has been incorporated as a criterion in the weighting matrix for the application of the AHP method.

The objectives that we set have been satisfied since it has been possible to establish in the first instance some criteria that intervene in the choice of the university career, of all of them we have considered the main and/or most comprehensive ones. The corresponding matrices have been formed without problems to carry out the respective analyzes and for the control case they have been consistent in all cases, it has been possible to establish with the method an order of priority in the choice of the career based on the criteria detected. ; and based on the defined criteria, it was found that the perception of the prestige of the Higher Education Institution is an incident in the choice of the university major; this criterion has generally been the second most important in the results of the student surveys; It was revealed to be of utmost importance when making decisions for the election; The geographical distance to the study center is also another criterion that has been weighted, which suggests that the geographical location of the educational institution is another relevant factor in students' decision making and the student's prior knowledge, together with the employment situation plays an influential role in the choice so weighted criteria have been considered for the analysis. This is not the case with the way in which the University courses are taken, the socio-economic level of the student, or the result of the vocational test, which have not manifested themselves as incidents in the students' preferences regarding the university course to follow.

Based on everything indicated and detailed above, it is considered that the hypothesis was sufficiently demonstrated.

FUTURE LINES OF RESEARCH

Once this work is completed, the following are proposed as future lines of research:

a) Implement the same decision-making model for more witness cases and carefully analyze the inconsistencies that may occur, mainly those where it is not verified that C1 < C2 < C3 < C4 < C5; Analyze the reason for the inconsistency through interviews or in any other way that is appropriate.

b) Analyze the comparison of the same criteria of this work with preference matrices different from the reciprocal comparison matrix used here, for example the additive or other models and compare results.

c) In order to definitively validate the proposal of this work, it will be necessary to carry out a diachronic monitoring of the performance in the university studies of students taken at random whose university career choices coincide with what is established in the AHP method implemented here and of students whose career choices university do not coincide with what is established in the AHP method implemented here.

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