MULTICRITERIA ANALYSIS FOR SITE SELECTION FOR A DISTANCE EDUCATION POLO OPENING

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ABSTRACT

In recent decades, the distance mode of education in Brazil has experienced strong expansion. Unlike classroom courses, which require large investments and do not reach all regions, in distance education courses the necessary physical structure is smaller and the territorial distance is not a limiting factor. However, for the growth of distance education courses to become more consolidated it is necessary that the model that guides the opening of new classroom support poles be improved. In this sense, the objective of this paper is to propose a tool, based on multi-criteria decision support techniques, specifically the AHP method, consisting of data and more solid information, to assist in the decision-making process on the most favorable cities to the opening new polo DE. The results achieved through the application of this tool, demonstrated that the criteria "local production arrangements" and "target audience", are the most relevant to the choice of a more appropriate place for the opening of classroom support poles.

Distance Education; Poles of Classroom Support; DE; Multicriteria decision; AHP method.

1. INTRODUCTION

Despite the strong expansion of the supply of distance education courses in recent years, the increase in enrollment and the aid of information technology tools, the existence of a minimal structure to cover the administrative and pedagogical requirements is necessary for the operation of distance education poles as art. 5 of the Decree 7589 of October 26, 2011.

Partnerships between the Federal Institutes / Network E-Tec Brazil and Municipalities, providing partners (Higher Education Institutions - IES) in agreement with the applicant partners (Municipalities, schools, etc.), through the so-called "term cooperation "(item XXVI, art. 24 of law 8.666 of June 21, 1996) establish the rights and obligations of both parties, so that the offered courses can function efficiently.

Among the duties of applicant partners, they have to offer minimum conditions of physical structure so that the courses can function. This condition is essential to carry out the on-site classes and support to students, who, during the course, need support to carry out its tasks in the online platform, according to art. 5 of the Decree 7589 of October 26, 2011.

The structure required should be available in the "Polo Classroom Support", Article 12, section 10 of Decree 5622 of December 19, 2005 which defines poles as operational units in the country or abroad, which will be organized jointly with other institutions for the decentralized execution of administrative pedagogical functions of the course.

The lack of a satisfactory physical structure can compromise the learning process and even worse, cause the stoppage of the polo operation, which is in economic and social harm to the served community. This problem could be minimized by a more careful choice when opening new centers of distance education.

The definition of a method, consisting of more comprehensive criteria on poles opening process, is of great importance to ensure that the most promising locations, among the ones established by these criteria, are the chosen ones. This will ensure that human and financial resources will be well employed.

This work aims to propose a new support tool in the process of opening the poles of classroom support. Therefore, this model is based on techniques of multicriteria decision aid (AMD), specifically, the AHP - Analytic Hierarchy Process.

2. LITERATURE REVIEW

The AHP method proposed by Saaty (1977) is a multi-criteria decision support methodology that aims selection, choice or prioritization of alternatives, in a process that considers different evaluation criteria.

The method is based on building hierarchies and parity judgments. On the steps of judging criteria and alternatives, the examiner (Saaty, 2008) compares equal numbers of elements of a layer or level of the hierarchy of each of the top layers of the hierarchy elements. If the problem has sub-criteria, they must pass the same process of assessment under each criterion. Finally, it compares the importance of the criteria based on the main focus.

The evaluators (experts) are individuals (or groups of individuals) responsible for the performance analysis or the degree of importance of the elements of a layer or level of the hierarchy in relation to those they are connected in the top layer.

From these opinions, matrices of judgments are generated. These matrices of judgments are reciprocal square matrices with unit values on the main diagonal. This way, AHP prioritization is done in four steps: 1. Obtaining judgment matrices; 2. Standardization of Judgment Matrices; 3. Calculation of Priority Medium Sites; 4. Calculation of Global Priorities averages.

Priorities Medium Sites (PMS) are obtained for each of the knot judgments, by the average of the columns of the standard tables. After completion of calculations of PMS, it will be possible to check what alternatives achieved the highest priorities in relation to the analyzed criterion. To calculate the Global Priorities (GP) is necessary to combine the PMS on the alternatives and criteria (and sub-criteria, if there are any). GP elements store performances (priorities) of the alternatives against the prime focus.

3. METHODOLOGY

After defining the focus of the main problem, it was conducted a technical study based on the laws applied to the management of distance education courses in order to understand its operation. So analyzing carefully the documents, this work tried to identify (among the criteria presented for the deployment of distance learning polo) which ones are more relevant and common according to the analyzed documents as it can be seen in the following list:

Number of inhabitants; Target Audience: Age range, Education, Income per capita, Home with internet access; Local clusters; Existence of High schools; Proximity of the city with universities; Local Competition: Existence of IES, other distance learning courses and other courses offered by the "S System".

In order to define the weight of each criterion, specialists working in distance education and teaching at public and private institutions, were interviewed. This is because the setting of priorities in AHP is based on the ability of human beings to perceive the relationship between observed objects and situations, comparing pairs under a certain focus or criteria (parity judgments). The questionnaire was structured according to the principle of AHP in digital format.

The questionnaires were tabulated and the results of each criterion were analyzed in a quantitative and intuitive way. In order to help on the value judgment of each criterion of the proposed problem scenario it was used the value judgment scale (Saaty, 2000). Table 5 as shown below, illustrates this range, which enables the examiner to issue his judgments in a very simplified way and by using natural language.

Value judgment to scale (Saaty, 2000)

Preference	Value	Preference	Value
Equal	1	Betwen strong and moderate	6
Between equal and moderate	2	Too strong	7
Moderate	3	Between strong and absolute	8

Moderate to strong	4	Absolute	9
Strong	5		

Table 05 - Scale

After the value judgments, the PML of each criterion is obtained. However, these judgments must maintain a logical consistency, once in the AHP, one can evaluate the constructed prioritization model regarding to its consistency. According to Costa (2004) the degree of inconsistency allows this demonstration through:

$$\mathbf{IC = |\lambda max - N| / (N-1)}$$

N - represents the order of the matrix
λmax - It is the largest eigenvalue of the matrix parity judgments.

According to Saaty cited in Costa (2004) the ratio of consistency can be measured by judging the matrix which may be in the order of up to 0,1. In case this information is confirmed, the model proves to be consistent and valid.

4. RESULTS

The list of criteria for the implementation of a Polo Distance Education, according to documents examined, was used as a basis for AHP in the composition and construction of the hierarchical tree of criteria and sub-criteria and their respective alternatives and priorities weights, as shown in figure 01.

Among the questionnaires given to experts to define the weights of each criterion, seventeen of them (17) presented complete tabulation of data, by using for both the Condorcet method. The method consists in comparing alternatives always in pairs and builds up a graph (BOAVENTURA Neto, 2003) that expresses the relationship between them. This process is performed in each questionnaire and the final result is the sum of the criterion points, as shown in tables 01 and 02.

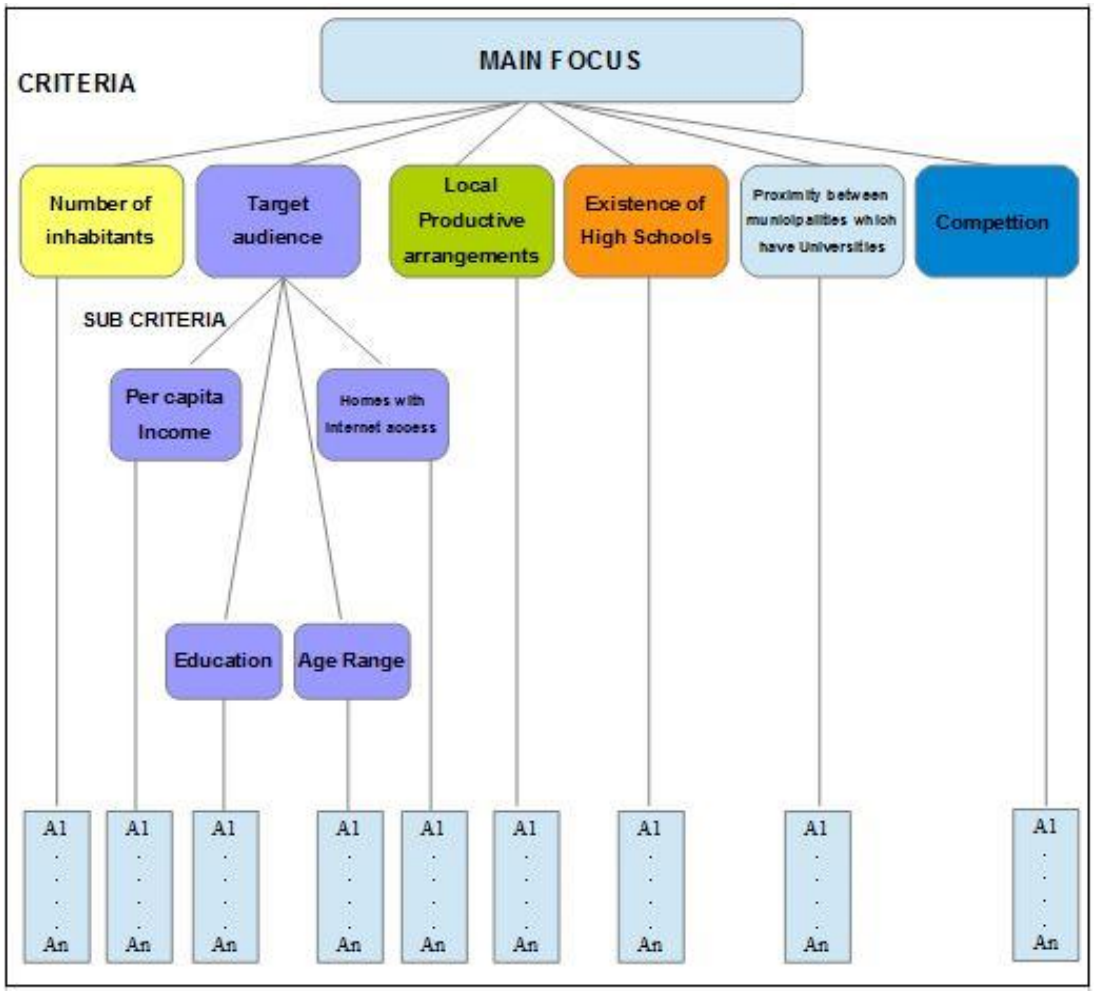

Figure 1 - Hierarchical Tree criteria and sub-criteria.

Analyzing the target audience	Total
Per capita income	39
Age range	47
Homes with access to internet	94
Education	107

Table 01 - Analysis

Analyzing the criteria	Total
Existence of High Schools	59
Number of inhabitants	89
Competition: existence of University institutions, other Distance Edicatin Courses and Distance Courses offered by Institutions such as SENAI and SENAC.	101
Distance or remoteness of the municipality compared to other municipalities where headquarters of universities are located in.	124

Target audience	134
Local Productive Arrangements are a set of economic, political and social factors, located in the same territory, developing related economic activities and which have production, interaction, cooperation and learning linkages.	161

Table 02 – Analysis

After the questionnaire, tabulation criteria was analyzed and according to the quantitative and intuitive analysis of their scores, star ratings were applied so as to define the relationships of importance and aim a better view, as shown in the following tables 03 and 04.

Analyzing the target audience	Total	Importance
Per capita income	39	**
Age Range	47	***
Homes with access to Internet	94	****
Education	107	*****

Table 03 - Criteria Analysis

Analyzing the criteria	Total	Importance
Existence of High Schools	59	**
Number of inhabitants	89	***
Competition	101	****
Distance or remoteness of universities in the area.	124	****
Target audience.	134	*****
Local Productive Arrangements	161	******

Table 04 - Criteria Analysis

Based on the value scale (Saaty, 2000), the criteria were judged and scored on pairs resulting in the matrix with the criteria judgments of the main problem focus as shown in Table 5. After this step it was obtained the PML of each criterion as shown in table 6.

Main focus	Productive Arrangements	Competition	Distance	Existence of High Schools	Number of inhabitants	Target Audience
Productive Arrangements	1	3	2	6	4	2
Competition	1/3	1	1/2	4	2	1/2
Distance	1/2	2	1	2	1	1
Existence of High Schools	1/6	1/4	1/2	1	1/2	1/5

Number of inhabitants	1/4	1/2	1	2	1	1/3
Target Audience	1/2	2	1	5	3	1

Table 05 - Criteria of Judgment

Main focus	Local Priority Average
Local Productive Arrangements	0,348
Target Audience	0,214
Distance	0,160
Compettion	0,132
Number of inhabitants	0,095
Existence of Schools	0,051

Table 6 - Priorities

The proposed model has a level of consistency within acceptable limits, less than 0.1 and the value of 0.038. In case the consistency is outside acceptable limits it´s necessary to reform the judgment value of the criteria (in pairs) or the model must be redone.

The same procedures were performed with the sub-criteria test "target audience". The sub-criteria were taken as pairs and implemented in IPE software, as described in Table 7 below.

Target Audience	Age range	Education	Per capita income	Homes with Internet Access
Age range	1	1/2	2	1/4
Education	2	1	5	2
Per capita income	1/2	1/5	1	1/4
Homes with Internet Access	4	1/2	4	1

Table 07 - Criteria of Judgment

After the judgment value, the software shows the calculation of the priorities of the sub criterion "target audience", as shown in Table 8:

Target Audience	Local Priority Average

Education	0,498
Homes with Internet Access	0,316
Age range	0,110
Per capita Income	0,077

Table 08 - Calculation of Priorities

The PML of the criteria and sub-criteria demonstrate the importance of each criterion compared to the prime focus of the problem. For the creation of new poles, DL criteria should be considered according to their importance in the following order: productive arrangements, target audience, distance, competition, number of inhabitants and existence of schools as shown in Table 06. The same is true for the sub-criteria in the following order of importance: education, homes with internet access, age range and income per capita.

5. CONCLUSIONS

The process of opening educational distance poles involves analyzing a number of socioeconomic, cultural, geographical and educational factors. In order to have better accuracy in the decision-making process, there's a need to create a model that addresses the key factors which culminate in a better choice of location.

According to experts in the field (professionals who have years of experience in distance education) the multi-criteria analysis method used, raised the main criteria for the opening of Distance Education Poles. The developed model is based on these Analysts´ scientific technical analyzes, reducing the guesswork and purely intuitive analysis, which may have different views among analysts.

The Condorcet method was used to score and standardize the opinion of each analyst on a general analysis of the criteria and define the criteria of weight in the model, thereby reducing the intuitiveness.

By using the weights of each criterion and value judgment in AHP, it was possible to define the priority of each criterion of the problem and check their consistency. So, within the analyzed criteria, the criteria "local production arrangements" and "target audience" can be considered very important when

choosing a town, because they make together 56.2% of the priority.

In this way, using the model proposed by this study, the city chosen for the installation of a probable polo of presence support, must present an economic vocation compatible with the possible courses to be offered besides having an audience group that can guaranty a lasting demand.

This is to allow the pole to operate for a reasonable period of time, offering conditions of several different classes, besides justifying the investment of human and financial resources that were invested in the pole, by the applicant partners and plaintiffs.

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