AHP PROCEDURES FOR DECISIONS IN A MULTI-ETHNIC SCHOLASTIC ENVIRONMENT

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ABSTRACT

The study is dedicated to the problem of multi-objective and multi-agent decision for the integration of the new generations in a multi-ethnic scholastic environment, that can favour cohesion in a multi-ethnic and culturally heterogeneous society.

For this purpose a case study is presented. In the research AHP procedures are applied to multi-objective and multi-agent decisions. Through AHP the alternatives were ranked, that is to say their alignment, in order of importance, or preference, on the basis of evaluation (Saaty, 1980; Saaty & Peniwati, 2007).

We move from the definition of the general objective (GO) of the analysis *"Integration in multi-ethnic scholastic environment"*. Such general objective (GO) is divided into two particular objectives: O1 = *social relations*; O2 = *scholastic success*. Besides, the sub-objectives O1 and O2 have been defined through the following criteria: C1 = *interaction and relations in class with peers*; C2 = *relations in the extra-curricular time*; C3 = *relations with the belonging environment;* C4 = *interaction and relations in class with teachers;* C5 = *linguistic-expressive abilities*; C6 = *logic-mathematical abilities*; C6 = *group abilities*; C7 = *group abilities*; C8 = *manual skills*; C9 = *sport skills*.

The alternatives considered are the actions A1=*Promote assimilation*; A2= *Promote multiculturalism*; A3= *Promote interculturalism* ; A4= *Let the present situation without changing anything*.

Keywords: Multi-objective and Multi-agent Decisions; Multi-ethnic Scholastic Environment; AHP Procedures.

1. Assimilation, multiculturalism, interculturalism

The question of integration of new generations and the building of living together is particularly significant in the current society. In the second half of the twentieth century International migrations have been considered one of the principal factors of social transformation. Their importance increases in the 21st Century, because the mobility of people increases in volume and it takes on new forms. Migrations are the result of integration in local communities and national economies as regards global relations (Sassen, 2007; Castles, 2002).

The growth of a "new" youth presence of immigrant origin sets a series of crucial challenges in order to redefine social life in the welcoming countries (Besozzi & Colombo & Santagati, 2009). The questions and the challenges that the multiethnic societies (Bauman, 1998) have to face regard: scholastic involvement of students that have not learnt as their first language the one taught in the schools; the creation on renewed basis of a civil con science and a National identity regarding scholastic communities that cannot consider the students as having a common nationality; the increasing cultural and religious pluralism; discrimination

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injustices based on ethnic basis that continues to verify on the job market (Kymlicka, 1995; Commission of the European Communities, 2008).

Therefore, the reflection on "new generations" becomes the privileged area to discuss the future of western societies, the possibility of economic and cultural enrichment, the building of social cohesion (Council of Europe, 2008).

As regards the question of future living together in a multi-ethnic society school takes on a central function because: it is characterized in a growing measure for a plural experience (in the classrooms there is a plurality of languages, of cultures, differentiated levels); that is the key institution for the acquisition of necessary competences for social and economic integration of the citizens of tomorrow, looking towards social cohesion (Cesareo, 2004; Ambrosini, 2008).

In the current sociological debate there are different explicative models of integration processes, that are at the basis of the different social policies and, specifically, of education:

- assimilation theories;
- multiculturalism;
- interculturalism.

The theoretical background of most of the studies on integration is formed from the assimilation paradigm, that considers assimilation as an organic process, univocal and linear: the encounter with the different is solved progressively and inevitably with the assimilation in the new social context and the adhesion of a dominant cultural model (Park & Burgess, 1924).

Cultural assimilation creates the assumption for social mobility: only if the immigrants assimilate and lose their cultural traits and social practices of their country of origin and manage to progress in the social ladder and not to disturb the balance of the receiving society. The universalist perspective is at the basis of assimilation policies models of the management of the interethnic living together, as the French and American one. In the last decade of the 19th century neo-assimilationist theories developed that reproposed the concept of "assimilation" purifying it of the normative and ethnocentric (Alba & Nee, 1997). In particular Brubacker (2001) underlines that new generations of immigrants assimilate to the autochthonous population for linguistic uses, matrimonial bonds, collocations on the job market. Portes and Rumbaut (2001) give a complex and problematic vision of the concept of assimilation through the segmented assimilation theory, that puts the accent on the conditions within which integration takes place. The integration process is fragmented along trajectories that can be of ascending mobility or descending mobility.

Multiculturalism places the accent on the irreducibility of cultural diversity and conceives a social universe clearly and distinctly divided in different cultures that social groups carry (Ambrosini, 2008). The model of multiculturalist society presents itself with many single cultures that are distinct and separate.

The intercultural model suggests the recognition of differences within a common horizon. The intercultural approach offers a model of management of cultural diversity based on the respect of such diversities and on equal dignities of each person and on the sharing of fundamental rules and values, considering social cohesion (Council of Europe, 2008).

The intercultural society qualifies for a plurality of contacts, relations and exchanges among different cultures, that are called at the same time to have a nucleus of universal and inalienable values.

Translating the intercultural integration process in mathematical terms, the meeting between *culture a* and *culture b* is conceived not as *a* containing *b* or *b* containing *a*. It is about elaborating a special operation of aggregation between the two different cultures *a* and *b* that produces a superior result both for *a* and for *b*.

In other words, intercultural integration is considered as a cooperative game with *n* persons, so when two coalitions are in contact, one with *culture a* and one with *culture b*, a new coalition is formed, whose value is superior to the sum of the value of the two coalitions.

In the language of the theory of complex dynamic systems, this is interpreted on the basis of a rule according to which the composition of interacting components in the coalition is superadditive (*superadditive composition rule*) (Foerster von & Zopf, 1962). The system is conceived as something more then its components considered in an isolated manner or juxtaposed. The quality of a system that present a new character compared to the qualities or proprieties of components considered isolated or disposed in a different manner in another system are called emergency. Emergency is a product of the organization that, even though inseparable from the system as a whole, not only appears on a global level, but it can be manifested at a components level, that is to say there are systems in which macro emergency acts in reverse on the parts as micro emergency (Neumann von & Morgenstern, 1947; Neumann von, 1951). Therefore, not only the whole is more than the sum of the parts, but also the part is, in the whole and tank to the whole, more than the part (Bertalanffy von, 1968; Prigogine, 1968; Morin, 1984).

2. The proposed AHP model for decisions in a multi-ethnic scholastic environment

2.1 The procedure adopted for the fuzzy weights of criteria

The paper addresses the problem of multi-objective and multi-agent decision for the integration of new generation in a multi-ethnic scholastic environment that, can promote cohesion in culturally heterogeneous society.

The general objective (GO) = *"Integration in multi-ethnic scholastic environment"*.
is divided, with reference to the scientific literature on the subject, in two specific objectives:

- O1 = *social relations*;
- O2 = *scholastic success*.

With the AHP procedure to each one of these sub-objectives is associated a weight with respect to the general objective.
In addition, each of the sub-objectives is specified by the following criteria:

- C1 = *interaction and relations in class with peers*;
- C2 = *relations in the extra-curricular time*;
- C3 = *relations with the belonging environment*;
- C4 = *interaction and relations in class with teachers;*
- C5 = *linguistic-expressive abilities*;
- C6 = *logic-mathematical abilities*;
- C7 = *group abilities*;
- C8 = *manual skills*;
- C9 = *sport skills.*

With the AHP procedure to each one of these criteria is associated a weight with respect to the sub-objective O1 and O2.

For the definition of objectives and criteria and to evaluate their scores have been used the opinions of a group of 12 experienced teachers in a primary school in Pescara, where the problem of *"integration in a multi-ethnic scholastic environment"* is particularly felt (Contini & Maturo, 2009). The teachers can be considered privileged observers. Every teacher $T^{(r)}$, r = 1, 2, ..., 12 is requested to compile three matrices of pairwise comparisons:

1. The matrix $A^{(r)}$ of the sub-objectives O1 and O2;
2. The matrix $M^{(r)}$ of the criteria C1, C2, ..., C9, with respect to sub-objective O1;
3. The matrix $N^{(r)}$ of the criteria C1, C2, ..., C9, with respect to sub-objective O2.

The approach is the one considered in the Analytical Hierarchy Process (Saaty, 1980; Saaty, & Peniwati, 2007). Let $X_1, X_2, ..., X_m$ be the objects to compare (e.g., sub-objectives or criteria). Every teacher T, if considers X_i preferred or indifferent to X_j, then is requested to estimate the importance of X_i with respect to X_j using one of the following judgments: *indifference*, *weak preference*, *preference*, *strong preference*, *absolute preference*. The judgment chosen is said to be the *linguistic value* associate to the pair (X_i, X_j). Then the linguistic values are expressed as numerical values following the *Saaty fundamental scale*:

- indifference = 1,
- weak preference = 3,
- preference = 5,
- strong preference = 7,
- absolute preference = 9.

The scores 2, 4, 6, 8 are used for intermediate valuations.
If the object X_i has one of the above numbers assigned to it when compared with object X_j, then X_j has the reciprocal value when compared with X_i. Then a pairwise comparisons matrix A = (a_{ij}) with m rows and m

columns is associated to the m-tuple $(X_1, X_2, ..., X_m)$, where a_{ij} is the number assigned to X_i when compared with X_j.

Let $Y^{(r)} = (y_{ij}^{(r)})$ denote the generic element of the set $\{A^{(r)}, M^{(r)}, N^{(r)}\}$. The synthesis of the teachers' opinions is made by considering, for every each pair (i, j) of indices, the following numbers:

 a. *the geometric mean* G_{ij}^{Y} of the opinions of the teachers, defined by the formula:

$$G_{ij}^{Y} = (y_{ij}^{(1)} \, y_{ij}^{(2)} \, ... \, y_{ij}^{(12)})^{1/12}; \qquad (1)$$

 b. a number U_{ij}^{Y}, called *the index of multiplicative uncertainty* of the opinions, defined by the formula:

$$U_{ij}^{Y} = \exp\sqrt{\frac{\sum_{r=1}^{12}[\ln\frac{y_{ij}^{(r)}}{G_{ij}^{Y}}]^2}{12}} . \qquad (2)$$

The choices of G_{ij}^{Y}, and U_{ij}^{Y} are justified by the following interesting propositions:

Proposition 1.1. For every pair (i, j), the following properties hold:

(G1) $\min_r y_{ij}^{(r)} \leq G_{ij}^{Y} \leq \max_r y_{ij}^{(r)}$, then $1/9 \leq G_{ij}^{Y} \leq 9$;
(G2) $G_{ij}^{Y} = 1/ G_{ji}^{Y}$.

Proposition 1.2. For every pair (i, j), we have:

(U1) $U_{ij}^{Y} \geq 1$ and $U_{ij}^{Y} = 1$ iff $y_{ij}^{(1)} = y_{ij}^{(2)} = ... = y_{ij}^{(12)}$;
(U2) $U_{ij}^{Y} = U_{ji}^{Y}$;
(U3)   let $y_{ij}^{(p)} = \min_r y_{ij}^{(r)}$, and $y_{ij}^{(q)} = \max_r y_{ij}^{(r)}$; then

$$U_{ij}^{Y} \leq \max\{G_{ij}^{Y}/ y_{ij}^{(p)}, \ y_{ij}^{(q)}/ G_{ij}^{Y}). \qquad (3)$$

Proposition 1.1 and 1.2 and the property of U_{ij} to be a pure number allows us to assume as *group opinion* of teachers on the pair (X_i, X_j) of objects the *fuzzy triangular number* $F_{ij}^{Y} = (G_{ij}^{Y}/U_{ij}^{Y}, G_{ij}^{Y}, G_{ij}^{Y} U_{ij}^{Y})$, with *core* the geometric mean G_{ij}^{Y} and *endpoints* obtained multiplying the core by the reciprocal positive numbers $1/U_{ij}^{Y}$ and U_{ij}^{Y}, respectively. The fuzzy number F_{ij}^{Y} is degenerate if and only if all teachers have the same judgments.

In conclusion, using the AHP and the foregoing procedure, each criterion C j is assigned a weight p_j and an index of uncertainty v_j. The sum of the weights is equal to 1, any index of uncertainty is greater than or equal to one. The fuzzy weight of criterion is given by the triangular fuzzy number

$$t_j = (p_j/v_j, p_j, p_j \, v_j). \qquad (4)$$

2.2 The procedure for selecting the alternatives

The purpose of this study is to identify the most effective strategies to promote the integration of new generations of immigrants and natives in scholastic contexts characterized by the presence of students with different cultural backgrounds. A good scholastic integration is in perspective an important prerequisite for social integration, development of social bonds and, therefore, for cohesion in multi-ethnic and culturally diverse societies. To this end, with reference to the scientific literature, we identified four possible strategies:
 • A1= *Promote assimilation;*
 • A2= *Promote multiculturalism;*
 • A3= *Promote interculturalism;*

- A4= *Not to change anything*.

At this stage it is assumed that an expert (or a committee of experts) calculated, for each criterion Cj, the matrix M(Cj) of pairwise comparisons of alternatives with respect to the criterion. Using the AHP procedure we obtain the vector $p_j = (a_{1j}, a_{2j}, a_{3j}, a_{4j})$ of the scores of alternatives with respect to the criterion C_j.
The score of the alternative Ai, i = 1,2,3,4 is given by the triangular fuzzy number:

$$s(Ai) = a_{i1}t_1 + a_{i2}t_2 + \ldots + a_{i6}t_6. \tag{5}$$

The best choice of alternative depends on the core of the fuzzy number, since it expresses the action that is preferable on average. But in choosing a role is attributed to the width of fuzzy number, which represents the divergence of expert opinion. Finally the scores are only an aid to the choices of politicians. If the differences between scores are not high then they are especially important policies of evolution and development of society.

3. Results and conclusions

Applying the theory held in the previous section we obtained, as the weights of the criteria, the following triangular fuzzy numbers (Contini & Maturo, 2009)

$t_1 = (0.235, 0.289, 0.356)$; $t_2 = (0.140, 0.187, 0.249)$; $t_3 = (0.123, 0.158, 0.203)$; $t_4 = (0.033, 0.047, 0.065)$;
$t_5 = (0.078, 0.106, 0.144)$; $t_6 = (0.055, 0.074, 0.099)$; $t_7 = (0.033, 0.045, 0.060)$; $t_8 = (0.047, 0.063, 0.085)$;
$t_9 = (0.024, 0.032, 0.043)$.

Using the expertise we have achieved for each criterion Cj the matrix M(Cj) of pairwise comparison of alternatives. The matrices are written by rows, with the symbolism of Mathematica.

M(C1) = {{1, 5, 1/9, 1/3}, {1/5, 1, 1/9, 1}, {9, 9, 1, 9}, {3, 1, 1/9, 1}}; M(C2)={{1, 3, 1/7, 1}, {1/3, 1, 1/9, 1}, {7, 9, 1, 7}, {1, 1, 1/7, 1}}; M(C3) = {{1, 1/9, 1/9, 1}, {9, 1, 3, 5}, {9, 3, 1, 1}, {1, 1/5, 1, 1}}; M(C4) = {{1, 5, 1/3, 3}, {1/5, 1, 1/3, 3}, {3, 3, 1, 7}, {1/3, 1/3, 1/7, 1}}; M(C5) = {{1, 3, 1/3, 3}, {1/3, 1, 1/5, 3}, {3, 5, 1, 3}, {1/3, 1/3, 1/3, 1}}; M(C6) = {{1, 1/3, 1/3, 1}, {3, 1, 1/5, 1}, {3, 5, 1, 3}, {1, 1, 1/3, 1}}; M(C7) = {{1, 5, 1/5, 3}, {1/5, 1, 1/7, 3}, {5, 7, 1, 7}, {1/3, 1/3, 1/7, 1}}; M(C8) = {{1, 1/3, 1, 3}, {3, 1, 1/3, 5}, {1, 3, 1, 3}, {1/3, 1/5, 1/3, 1}}; M(C9)={{1, 5, 1/3, 1}, {1/5, 1, 1/3, 1}, {3, 3, 1, 5}, {1, 1, 1/5, 1}}.

By calculating the eigenvectors we obtain the following matrix of the scores of alternatives with respect to the criteria:

Scores = {{0.110902, 0.129596, 0.0435397, 0.296875, 0.255872, 0.120491, 0.221209, 0.207163, 0.246802}, {0.0597027, 0.0695368, 0.451318, 0.126171, 0.137521, 0.189811,0.0903391, 0.321, 0.105314}, {0.70463, 0.704971, 0.393457, 0.512944, 0.516027, 0.539531, 0.631202, 0.396472, 0.513062},{0.124766, 0.0958958, 0.111685, 0.0640108, 0.0905801,0.150167, 0.0572497, 0.0753646, 0.134822}}.

Applying the formula (5) obtain the following fuzzy scores of alternatives
s(A1) = (0.108902, 0.14406, 0.190154), s(A2) = (0.125203, 0.163777, 0.214216), s(A3) = (0.451308, 0.586166, 0.760955), s(A4) = (0.0825866, 0.106997, 0.138676).

The analysis leads to prefer A3, *promote interculturalism*, by far than the other alternatives, while the alternative A4, to prefer the status quo, appears to be the worst choice.

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