



Cased-based reasoning and neutrosophic logic to identify the employment limitations for Law school graduates at UNIANDES Ibarra

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Abstract. The objective of this study is to identify the employment limitations for Law school graduates at UNIANDES Ibarra, depending on their competencies and functions. For that purpose, we analyzed theoretical referents addressing the follow-up programs for higher education graduates. Moreover, we applied field descriptive investigation with a quantitative approach for an integrated sample of 122 Law school graduates, using questionnaires as instruments, as well as making a statistical descriptive analysis, given the previously executed qualitative analysis, which facilitated data interpretation. After making use of case-based reasoning to obtain the main employment limitations affecting Law school graduates, these limitations are analyzed using Neutrosophic logic in order to recommend and correct the more urgent limitations Law school graduates have to deal with, so that these graduates can start working as soon as possible.

Keywords: Professional skills, Law school graduates, employment limitations, higher education graduates follow-up, case-based reasoning, Neutrosophic logic.

1 Introduction

Graduates tracking is a process that has acquired great importance for higher education over the last times. The first registered antecedents go back to XIX century, when, for example, in the European and North American models, they made emphasis in achieving that graduates acquired a profile meeting the requests of society, trying to guarantee their effective incorporation to the working market, which requires a follow-up from the institution.

In addition, during the Second World War, in developed countries, they remarked the need to evaluate the competences of higher education graduates and its repercussion in the working markets. During the second half of the XX century, with the emergence of communication systems, the production and the administration, the relations between the countries and consequently their working interchanges were transformed [1].

From the year 2000 on, they have been monitoring graduates' performance repercussion to integrate the business environment. An aspect that has become a topic of special interest, since it is tightly related to the competencies approach. Even though it was first mentioned a few years before, specifically in the book *Aspects of the Theory of Syntax* by Noam Chomsky [2], published in 1965, competences approach starts to be applied frequently in universities during the '70s.

Author [3], considers that competence is what explains and predicts the conduct of the ideal subject and proposes to describe it by means of the elaboration of a grammar that he called generative. Right from its beginnings, the use of competences also becomes associated with other life activities, such as corporate and businesses world.

Based on the facts previously stated, they use the term professional competences due to its relation with the search of a better qualification to assume specific tasks in a certain job. [4] and [5] appeared in the psychology research carried out in the University of Harvard, who, through the publication of a paper namely: *Testing Competence Rather than Intelligence*, defined the competence as the main characteristic related to the efficient performance of a person at work.

In Ecuador, professional competencies are supported by the revision of the educational quality, which demanded the implementation of mechanisms to monitor graduates activities, tasks, performance, positions, roles and functions. The implemented mechanisms opened new spaces for institutional self-evaluation. In particular, these spaces initialized at the University of Loja (UNL) in 2005, with the first officially graduates [6].

The aforementioned mechanisms are based on what is established by the Organic Law of Higher Education , where is considered the instrumentation of a follow-up professionals for their respective evaluation. These mechanisms are operationalized through the Council for the Evaluation, Accreditation and Quality Assurance of Higher Education (CEAACES), through the processes of evaluation and accreditation of Higher Education Institutions and their academic offers.

It is worth highlighting that the Regional Autonomous University of Andes (UNIANDES) constitutes a paradigm of the mentioned above. This university has a graduate's follow-up program, keeping in touch with the graduates through a Web site, offering the possibility to register, access to services, find employment options and access to a list of employers. For UNIANDES Ibarra extension, tracking of the graduates constitute a valuable source of information that generates a communication network between the forming institution and the graduates, inasmuch as the professionals' accumulated experience allows obtaining data about the working situation, training needs, postgraduate studies requirements and level of professional satisfaction.

Results obtained from graduate's follow-up make possible to adjust career and imparted programs through curricular update. However, considers that UNIANDES follow-up program has some faults because it does not gather all the information required by the academic instances.

According to the above mentioned, graduates, follow-up is a need for all Higher Education institutes in Ecuador. Although, it is evident that important efforts are being made, since systematic methods are applied to meet the characteristics and requests of the students and those of the community contexts.

The previously stated is corroborated with the results obtained by UNIANDES Ibarra, in the IV Encounter of Graduates in 2017, in which the generated information became a first-rate asset for the university. Standing out lately, as a reference for the rest of the higher education institutes in Ecuador, useful to describe the graduate's employment options and, especially those of Law school, given the competences and functions of graduates that took part in the IV Encounter of Graduates UNIANDES Ibarra.

In the same scenery, it was analyzed and demonstrated the good preparation of graduates through the results obtained from different projects, especially, taking as a reference the Career After Higher Education project; an European Research Study, in which they analyzed the working competences of thirty and six thousand graduates during three consecutive periods. This project was implemented in the National University of Colombia, op. cit.

Also, in the before related encounter, they made an analysis of the results from several projects, especially taking into account the project that it was implemented in Europe in 2000, known as Tuning project, which reached numerous countries in Latin America. Continental initiatives were also taken into account; they were analyzed with the implementation of the Reflex project in 2004, (The Flexible Professional in Knowledge Society). In a similar way, they analyzed the initiatives coming from the Proflex project (Flexible Professional in Knowledge Society)[7] for European and Latin American countries.

On the other hand, studies addressing the follow-up of higher education graduates were carried out, standing out the ones from, and at the Central University of Ecuador, at the Pontifical Catholic University of Ecuador (Quito) and at the Regional Autonomous University of Andes, respectively. These studies revealed the importance of programs related to the monitoring of graduates, the authors proposed the use of advanced technological resources and management strategies to improve the professional skills of graduates.[8]

In the universities of the Americas (UDLA) and in the Inter-University Centers for Development (CINDA), in 2015, [6], studies with results relative to the graduate's follow-up were carried out. In these studies, they highlighted the contribution of these follow-ups to the adjustment of the university courses, allowing being aware of the weaknesses and existent strengths and the development of curricular programs.

The perceptions and opinions on the connections between higher education and the working world allude to the preparation of the students for their insertion into the society of the apprenticeship, economic and social internalization, attention to generic or transversal competencies, social skills and to the development of their talents. That is why the demands of the universities in the international environment have influence in the fortification of the evaluation of university activities, which constitutes a way to compensate society.

At UNIANDES Law School, the previously mentioned follow-up, contributes to the formation of professionals for the solution of juridical problems in social, economic and political sectors, in the administration of justice. Moreover, it produces fourth level human resources with competences for the criticism, reflection, analysis and solution of problems in particular juridical contexts. Given the transcendence of the Law school, it is necessary to know how the graduates from this course must have abilities to create, interpret and apply the Law, to intercede and facilitate the resolution of social conflicts and the improvement in reconciliation mechanisms.

Studies indicate that the Law school graduates must possess a dynamic society; they must be prepared to struggle for the application of justice sustained in value, ethical principles, democracy, solidarity and human rights. The evaluation of these graduates is essential to validate that they are ready to go into the working world.

Based on the completed study, the obtained results from the projects; Reflex (The Flexible Professional in Knowledge Society), Proflex (Flexible Professional in Knowledge Society), in the project that was implemented in Europe in 2000, known as Tuning project and that included countries from Latin America[8], in the Career After Higher Education project; A European Research Study, that was a reference for the Ecuadoran universities, as well as the IV Encounter of Graduates in 2017, at UNIANDES Ibarra. All that data were stored in a database, which was classified as a Knowledge Base to analyze the limitations that most affect Law school graduates when inserting themselves into the working world.

The obtaining of such limitations was made through case-based reasoning, which is an Artificial Intelligence technique and a paradigm of solution for problems based on the use of previous experiences to solve new problems. That's why it is used in this work to find the main limitations of Law school graduates in the Ecuadoran universities when they go into the working world, given the stored characteristics in the Base of Cases related to the results of the previously mentioned projects.

The case-based reasoning is very useful since with this technique it is possible to measure experiences in previous situations and use them later in present situations. So to say, a new problem is solved by searching in the previously created Database/Case Base, where a similar case was solved in the past. Afterwards a suggested solution is evaluated, taking into account the formerly solved cases, to try to apply the same solution to the current problem .

Once the main limitations of Law school graduates are obtained, neutrosophic logic[9] is used to treat the limitations that most affect Law school graduates when they enter the working world. Neutrosophic logic derives from Neutrosophy, new branch of philosophy that studies the origin, nature and scope of neutralities created by [10] Neutrosophic logic and sets constitute a generalization of fuzzy logic and sets [11], and especially of the intuitionist logic of , with multiple applications in the decision-making field, images segmentation and machine learning[12].

2 Materials and methods

In this work, a descriptive field investigation with a quantitative approach was carried out [1], with the objective of investigating and describing the relevance of Law school in the next five years, the graduate's employment options and their competences and functions; for which primary relevant data were obtained. The selected sample consisted of 122 Law school graduates at UNIANDES Ibarra. The sample selection

was not probabilistic and the selection criterion was to consider all graduates participating in the encounter of graduates that took place in 2017. The instrument we used to gather the information was a questionnaire designed by UNIANDES, which was adjusted and structured in three dimensions:

1. Trends in the Occupational Market: containing four questions.
2. Occupational Demand (employability): inquires about five aspects.
3. Training and feedback: addresses one aspect.

Descriptive statistics tools; analytic and relative frequency, served as data analysis technique [13]. The obtained figures were analyzed by means of the theoretical principles sustaining the study. Once the results of the three measured dimensions in the questionnaire designed by UNIANDES Ibarra were obtained, they were compared with the results stored in the previously created Case Base, to save the main limitations and deficiencies of Law school graduates. The comparison was carried out through a case base reasoning[14], from which we obtained the main limitations for Law school graduates when they enter the working world.

The limitations for Law school graduates were analyzed through neutrosophic logic, assigning a linguistic scale of single value to each limitation, to facilitate the knowledge of, how bad or how well the graduates are or how great the graduates are, or how badly the graduates are, among other linguistic terms of interest. The procedure to be followed is shown in Figure 1, which represents the workflow to measure the employment limitations of Law school graduates in Ecuador and indicates which are the ones that need to be corrected the most.

The proposed workflow is based on the proposal of [15], for knowledge-based recommendation systems, which allows representing linguistic terms and indeterminacy by means of single valued neutrosophics numbers (SVN).

Definition 1. Let X be a set of objects and $x \in X$ represents a single valued neutrosophic number (SVN) and is characterized by a vector (V, I, F) where V indicates truth-value, I indeterminacy-value and F falsity-value.

Single Valued Neutrosophic Set (SVNS) concept permits the application of neutrosophic set theories on many real world scientific and engineering applications [13], see definition1. Many studies have been done on this theory and have been used in many application fields. In SVNS values of truth, falsity, and indeterminacy of a situation are considered. Many uncertainties and complex situations arise in decision-making applications where id useful to model using SVNS [16-18].

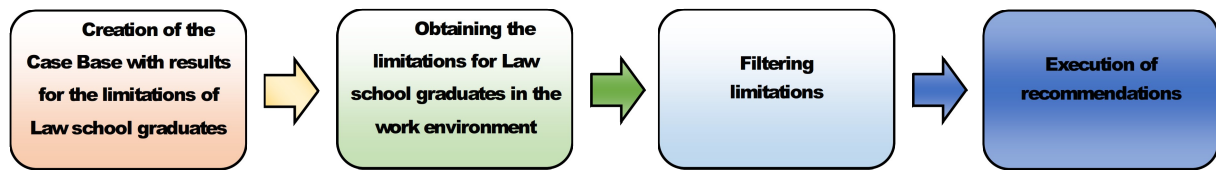


Figure 1. Workflow to measure Law school graduates limitations in Ecuador.

The detailed description for each activity and the workflow to measure the limitations of Law school graduates in Ecuador, supporting the proposal to indicate which are the limitations that need to be corrected the most, is presented below.

1. Creation of the Case Base with results for the limitations of Law school graduates

Each one of l_i limitations is described by a set of characteristics that will represent the limitations for Law school graduates in Ecuador.

$$A = \{a_1, \dots, a_k, \dots, a_l\} \quad (1)$$

In order to obtain the limitations for Law School professionals in the working environment through a Case Base, neutrosophic single value numbers (SVN) are used [19]. Where $A^* = (A1^*, A2^*, \dots, An^*)$ be a regular vector SVN, such that $Aj^* = (aj^*, bj^*, cj^*)$, $j = (1, 2, \dots, n)$ y $Bi = (Bi1, Bi2, \dots, Bim)$, $(i = 1, 2, \dots, m)$; Let it be m vectors of n SVN numbers such that y $Bij = (ij, bij, cij)$ $(i = 1, 2, \dots, m)$, $(j = 1, 2, \dots, n)$ then the Euclidean distance is defined as Bi y A^* according to the expression 2, defined by [20].

$$d_i = \left(\frac{1}{3} \sum_{j=1}^n \left\{ (|a_{ij} - a_j^*|)^2 + (|b_{ij} - b_j^*|)^2 + (|c_{ij} - c_j^*|)^2 \right\} \right)^{\frac{1}{2}} \quad (2)$$

Based on Euclidean distance, according to [21], a measure of similarity can be defined. The closer alternative A_i is to the limitations of Law school graduates in Ecuador once they enter the working world (s_i), the greater the similarity, which allows establishing an order between alternatives.

The employment limitations for Law school graduates in Ecuador are obtained directly from Case-Based Reasoning. The assessments of the limitations of those Law school graduates in Ecuador who entered into the working world are defined by a_j . They are expressed by using the linguistic scale S , $v_k^j \in S$, where $S = \{s_1, \dots, s_g\}$ is the set of defined linguistic terms to evaluate the characteristics c_k using the SVN numbers.

The linguistic terms to be used are defined once the set of limitations $A = \{a_1, \dots, a_j, \dots, a_n\}$ has been described and subsequently these limitations are saved in the previously created Database, to be taken as new cases to be evaluated.

2. Obtaining the limitations for Law school graduates in the work environment

In this step, we obtain the information about the kind of work done by Law school graduates in Ecuador. When the main limitations of these graduates entering the working world are known, they are represented as follows:

$$P_e = \{p_1^e, \dots, p_k^e, \dots, p_l^e\} \quad (3)$$

These limitations are integrated by a set of attributes that are represented by:

$$C^e = \{c_1^e, \dots, c_k^e, \dots, c_l^e\} \quad (4)$$

where: $c_k^e \in S$

3. Filtering limitations

In this step, limitations are filtered according to the profile or knowledge areas related to the Law, according to these graduates' positions, in order to find which are the limitations that have a significant impact on the work they do and their performance. For this purpose, the similarity between the limitations according to the areas of knowledge where Law school graduates work is calculated, P_e and each a_j limitation in general is stored in the Case Base. Equation 5 is used to calculate the total similarity [14].

$$s_i = \left(1 - \frac{1}{3} \sum_{j=1}^n \left\{ (|a_{ij} - a_j^*|)^2 + (|b_{ij} - b_j^*|)^2 + (|c_{ij} - c_j^*|)^2 \right\} \right)^{\frac{1}{2}} \quad (5)$$

Function S calculates the similarity between the values of the attributes of limitations for Law school graduates according to a specific knowledge area and the limitations of Law school graduates in general, entering the working world, a_j .

4. Execution of recommendations

Once the similarity between the limitations of Law school graduates is calculated, which are stored in the Case Base and defined each limitation for Law School graduates according to the area of knowledge where they work, they are ordered according to the similarity obtained and are represented by the similarity vector, according to expression 6.

$$D = (d_1, \dots, d_n) \quad (6)$$

Limitations to take into account will be those that best meet the needs of Law school graduates, that is, limitations with greater similarity.

3 Results

From the analysis of the dimension related to occupational market trends: containing four questions, we can conclude that the academic preparation received by UNIANDÉS Ibarra graduates has been Very Good, so there is an ample satisfaction in this regard. Consequently, we can assure that the university efficiently contributed to the development of professional skills, which are complemented by attitudes and values, expertise, knowledge and skills that have facilitated their performance in their respective work environments.

On the other hand, it is exposed that Law school graduates agree to change the Law school study plan. In particular, they propose the update of the curriculum in a profession that is constantly changing. This is justified by the curricular review carried out, which is a response to social needs in the context of knowledge development so that there must be coherence between curricular design, social needs and the state of knowledge, as referred by [9].

In [10], it is pointed out that universities, as trainers of human resources, are in constant pursuit of quality in order to ensure that the student has the possibility of appropriation of knowledge and know-how, corresponding to the community of which they will be members, thanks to a training process. On the other hand, the aforementioned author thinks that universities try to ensure that graduates bring to their working environments the general values they obtain from their academic culture.

In the same dimension, the time it takes for a graduate to get a job is analyzed, emphasizing that they take less than a year, which is an encouraging and acceptable figure for the incorporation into the working market for any professional. This result allows us to specify that Law School in this region meets the socio-professional and legal needs of the environment because graduates find spaces where to consolidate their social and economic rights.

As for the aspects related to the occupational demand category, corresponding to the second dimension of the analysis, Law school graduates show some results. Such as being able to enroll in postgraduate studies at UNIANDÉS, which shows that these graduates continue to trust in the quality of the training programs of this institution, as well as allowing the possibility of continuing to improve in the Law school.

It is noteworthy that postgraduate studies are designed over the base of a thorough understanding of normativity, criticism and its comparison to other realities as referred by [22]. These studies provide the professional with the theoretical and conceptual tools they need to be efficient and with the kind of research that generates new knowledge related to problems on the field of Law. They also contribute to the adaptation of the exercise of this profession to the complex and changing reality.

Training programs offered by the universities, in their different levels, are focused on delivering to society a product endowed with qualities that make it compatible with the most up-to-date working and educational paradigms. The relationship between the formal educational component and the graduate is conceived, as previously stated, in a way that it should broaden its significant content from aspects that go beyond the merely academic.

In the analysis of the sector where Law school graduates work, corresponding to the same dimension, it is noted that most of the lawyers in Ecuador work on their own. There is also evidence of a high percentage of Law graduates who are dedicated to the free exercise of the profession, graduates who are qualified as entrepreneurs because they look for job stability.

Based on the previous analysis, it is noticeable that even though the most of Law graduates work on their own, they look for a way to insert themselves in the working market, in order to progress and sustain their families with their own means. These causes show that the employability indexes in Ecuador for Law school graduates are positive since they demonstrate the ability to meet market requirements and the ability to adapt to the context transformations.

A study concerning the position held by Law school graduates is carried out, from the first dimension, the results prove that these graduates perform their work activities providing legal advice, which involves public and private advice. Likewise, the lowest percentages correspond to executive positions, which indicates that Law school graduates do not hold management positions.

On the other hand, the remunerative levels for Law school graduates are analyzed. In this aspect, it is shown that lawyers' salaries vary from 600 to 1200 dollars. Range from 600 to 800 can be qualified as an income that is above the minimum wage, while, if it reaches 1200, it can be considered an acceptable salary, but still does not equal the remuneration a legal professional should earn.

When it comes to salary ranges, it is important to take into account that the economic crisis in Ecuador affects in a very special way the incorporation of young people into the working market and therefore their remuneration. A problem that, among other reasons, is a consequence of academic training is no longer a guarantee of a well-paid job. In this regard, it is important to refer to what is indicated by [23], when he says that in the professional area there are professions that are saturating the working market. That is why educational institutions must rationalize their academic offer. The unemployment rate is compensated by underemployment, which means that fewer and fewer people have well-paid good quality jobs.

Work experience of Law school graduates was analyzed, showing that the Law school graduates in Ecuador have been for more than 5 years in the last job. Which is a positive indicator that demonstrates the job stability and efficiency of the employees in the fulfillment of assigned functions. These reasons indicate that Law graduates have been able to successfully adapt to the labor field. Likewise, it is a proof that the received university academic training was in accordance with the demands of the market because it favored a balance between the requirements of the market and the competencies of the professional Law field.

In the aspect related to the third dimension concerning to training and feedback, the knowledge areas of Administrative Law stand out as a priority, since law graduates require knowledge about the update of norms and procedures regulating the activities in Public Administration. Then the training area in Public Procurement is also stood out, due to the need for recent theoretical information and practical application in aspects related to public procurement such as budget control, programming, administration and execution of public works acquisitions. Lastly, training in Environmental Law, which is the result of the need to acquire knowledge in a branch of law that is recent and that emerges as a new juridical tutelage interest.

In this area, we find the knowledge to constitutionally regulate the protection of the environment and the ecology, as well as the update interest on the regulations that control the Mining Law.

After obtaining the results, when applying the questionnaire developed by UNINDADE Ibarra, the workflow proposed in Figure 1 is applied to obtain the limitations that affect Law school graduates. For our case study we used the Case Base obtained from the previously created Database. Then we applied Case-Based Reasoning to compare the limitations affecting Law graduates, which are stored in the Base of Cases, and the limitations of Law graduates according to the area of knowledge where they work.

From the comparison we obtained the following limitations:

- Occupational market trends for Law graduates are based on the socio-professional and legal needs of the environment.
- Law school curriculum requires constant update, since it is a profession that is continuously transformed and must be in accordance with the socio-professional and legal environment.
- Occupational demand for Law school graduates is based on the possibility of being able to continue postgraduate studies to improve with regard to Law working environment.
- Most of the lawyers in Ecuador work for their own and devote themselves to the free exercise of the profession.

These limitations are represented in the Case Base as: $A = \{a1, a2, a3, a4, a5\}$, described by the set of attributes $C = \{c1, c2, c3, c4, \dots, c5\}$ valued through the linguistic scale of Table 1, whose valuations are stored in a Case Base.

Linguistic term	SVN
Extremely good (EG)	(1,0,0)
Very very good (VVG)	(0.9, 0.1, 0.1)
Very good (VG)	(0.8,0,15,0.20)

Good (G)	(0.70,0.25,0.30)
Moderately good (MG)	(0.60,0.35,0.40)
Medium (M)	(0.50,0.50,0.50)
Moderately bad (MB)	(0.40,0.65,0.60)
Bad (B)	(0.30,0.75,0.70)
Very bad (VB)	(0.20,0.85,0.80)
Very very bad (VVB)	(0.10,0.90,0.90)
Extremely bad (EB)	(0,1,1)

Table 1: Linguistic terms used.

To obtain recommendations on the limitations affecting those Law school graduates who entered the labor world, information expressing the knowledge areas they preferred was provided and they were evaluated, through the linguistic scale of table 1, to obtain linguistic values in accordance to the detected limitations.

According to the linguistic evaluation we made, the tendency of the occupational market for Law school graduates, which is based on the socio-professional and legal needs of the environment, is moderately good (MG). The aspect related to the constant update of Law school curriculum got a very good (VG) evaluation since it is a profession that is continuously transformed and must be in accordance with the socio-professional and legal environment. The occupational demand of Law school graduates is based on the possibility of being able to continue postgraduate studies, to further improve concerning the work environment of Law, obtained a value of very very good (VVG). Finally, most of the lawyers in Ecuador work on their own and devote themselves to the free exercise of the profession, obtained a very good (VG) result. These results are shown through the expression 7.

$$Pe = \{MDG, VG, VVG, VG\} \quad (7)$$

Once obtained the values for the main limitations for Law school graduates in Ecuador, according to the linguistic scale of Table 1, we proceed with the calculation of the similarity between the limitations in general and the specific limitations according to the knowledge area in which these graduates develop once they enter the working world. Results are shown in table 2.

a_1	a_2	a_3	a_4
0.55	0.80	0.38	0.85

Table 2: Similarity between the Law school graduates limitations in general and those according to the knowledge area where they work.

Based on the results obtained and shown in Table 3, it is recommended to pay attention to those limitations according to the knowledge area where Law school graduates work that is closer to the general limitations of these graduates entering the working world. The ordering of limitations is shown in expression 8.

$$\{a_4, a_2, a_1, a_3\} \quad (8)$$

In case of recommending the closest limitations, these would be those corresponding to the vector a_4, a_2 , which are related to the constant updating of the Law school curriculum, and Law school graduates who work on their own and devote themselves to the free exercise of the profession.

4 Conclusion

In this study, we described the employment possibilities for Law school graduates at UNIANDES Ibarra. We carried out an analysis from the theoretical referents, which addressed the characteristics of follow-up programs for higher education graduates. We applied a questionnaire developed by UNIANDES Ibarra, which helped us discover

the general limitations for Law graduates entering the working world. Limitations were stored in a Database, and then treated as a Case Base, through Case-Based Reasoning, as an Artificial Intelligence technique. The obtained results were evaluated through neutrosophic logic, in particular making use of a workflow to measure the limitations for Law school graduates in Ecuador. Which facilitated the recommendations of limitations having more influence in Law school graduates in Ecuador, affecting their work performance and the balance between the competencies acquired during their study stage and the working world.

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