

Adrian Castro-Lopez (Business Administration, University of Oviedo, Oviedo, Spain)
Sílvia Monteiro (University of Minho, Braga, Portugal)
Ana B. Bernardo (Psychology, University of Oviedo, Oviedo, Spain)
Leandro S. Almeida (University of Minho, Braga, Portugal)

Acknowledgements

This work is funded by CIEd – Research Centre on Education, Institute of Education, University of Minho, projects UIDB/01661/2020 and UIDP/01661/2020, through national funds of FCT/MCTES-PT.



Exploration of employability perceptions with blended multicriteria decision making methods

Journal:	<i>Education + Training</i>
Manuscript ID	ET-07-2021-0296.R1
Manuscript Type:	Research Paper
Keywords:	Higher education, work transition, employability, AHP, TOPSIS, fuzzy

Exploration of employability perceptions with blended multicriteria decision making methods

Abstract

Purpose – The purpose of this paper is to explore employment perception of students as a relevant indicator of higher education quality, using blended multicriteria decision making methods.

Design/Methodology/approach – The differential impact of these variables was analyzed in this paper taking a sample of 641 students and six higher education lecturers identified as experts on young vocational careers. The traditional study of student behavior and perceptions of employability does not incorporate the uncertainty associated with multi-criteria decision processes and is therefore less adapted to the human reasoning process. This research applies traditional techniques together with Fuzzy techniques capable of managing more effectively the uncertainty associated with student actions and behaviors.

Findings – This research shows that it is important to consider previous work experience, academic achievement, and soft skills developed during education experiences. In this way, this research shows the lecturers how to adapt their pedagogical practices according to students' perceptions of employability and assess their students' perceptions of employability. In addition, lecturers will be able to incorporate the uncertainty associated with decision making processes to optimize employability perception.

Originality/value – Higher Education related research on uncertainty environments as multicriteria decision problems is still in early stages. The incorporation of the uncertainty associated with decision making processes to this field allows to optimize employability perception thanks to its adaptation to real human behavior in the adoption of decisions.

Keywords Higher education, employability, vocational career, AHP, TOPSIS, fuzzy.

Paper type Research paper

Introduction

Several approaches to the concept of employability have been presented in the literature, across several disciplinary fields and from different perspectives. From an educational perspective, researchers have paid particular attention to the contributions of higher education on development of graduates' skills in order to be better prepared for labor market transition (Yorke and Knight, 2004; Dacre Pool and Sewell, 2007; Bridgstock, 2009; Habets et al., 2020; Jianu, and Grecea, 2020; Pavlin, 2020; Grosemans and De Cuyper, 2021).

In this process, individuals' perceptions are highlighted by authors such as Rothwell et al. (2008) in the definition of employability as a "perceived ability to attain sustainable employment appropriate to one's qualification level" (p.2). The relevance of individuals' perceptions is equally present in several employability models, such as the USEM model (Understanding, Skills, Efficacy beliefs, and Metacognition; Yorke and Knight, 2004), the CareerEdge model (Dacre Pool and Sewell, 2007) or the career management model proposed by Bridgstock (2009). In such perspectives, self-perceptions are seen as an important link between employability and knowledge, understanding, skills, experience and personal attributes (Dacre Pool and Sewell, 2007; Bennett and Ananthram, 2021). Indeed, it is by the engagement in reflective, evaluative and decision-making processes that student will be able, not only to effectively acquire, but also to exhibit their skills that will promote career opportunities. In this sequence, self-perceptions need to be considered for the understanding of employability (Bridgstock, 2009).

The development of such perceptions of employability, particularly in the context of previous individuals' experiences, is still under-researched (Rothwell et al., 2008; Wittekind et al., 2010; Turner, 2014; Bhopal et al., 2020; Grosemans and De Cuyper, 2021). One particular aspect important to tackle refers to the way academic staff, namely lecturers, perceive the development of such students' self-beliefs (Bhopal et al., 2020). Lecturers have a crucial role on the way students develop and perceive their skill improvements and achievements (Van Dinther et al., 2011; Ayllón et al., 2019; Perusso and Wagenaar, 2021). This enhances the relevance to explore the consistency between academic staff perceptions about students' perceived employability and effective students' perceptions about their employability. This understanding will inform how and where efficacy beliefs can be addressed by

lecturers as a way to promote graduates' employability (Turner, 2014; Jackson and Wilton, 2017; Perusso and Wagenaar, 2021).

However, studying these variables is not an easy task as multi-criteria decision making is purpose to many subjective judgements and therefore difficult to quantify in a simple way the importance of each variable within the evaluation model (Yannis et al., 2020; Guarini et al., 2021). This is why fuzzy methodologies are increasingly used to solve multi-criteria decision-making problems thanks to the use of a fuzzy language that is closer to human reasoning (Castro-Lopez et al., 2021). In this article we use fuzzy methodologies FAHP and FTOPSIS to analyze employability perceptions and establish a proper lecturing innovation plan in order to improve students' perceptions in terms of employability considering their respective scientific area of graduation. Specifically, the research questions in this paper are: Which factors are perceived by professors as relevant for students' perceived employability? Are professors' perceptions about students' perceived employability consistent with effective students' perceptions about their employability? Are these perceptions differentiated in function of scientific area of students' graduation?

Theoretical framework

Graduate unemployment affects countries all over the world (Eliška, 2016; Chadha and Toner, 2017), and this expectation of unemployment can discourage students from completing their studies. In consequence, higher education institutions are today more attentive to this reality and feel the need to explore new ways to promote the graduate employability of their students (Milner et al., 2016). The research in this field is increasingly multidisciplinary and addresses more diverse topics (Díaz, 2019), for example to explore the promotion and assessment of competence-based learning (Wolff and Booth, 2017), to examine whether we are really giving sufficient importance to training in transversal competences (Dieste, et al., 2019), to find out whether curricula are adapted to labour market needs (Fernández, 2017), and to assess whether universities are really implementing plans to promote the employability of their graduates (Chadha and Toner 2017).

In the research on employability, there are some works that consider the study of the subject's personal variables (González and Martínez, 2016; Izquierdo and Farias, 2018) and ask basic questions such as are our students prepared for access to the labor market? And even more so, do they perceive themselves competent to successfully access the professional world?

Work experience and perceived employability

Work experience during higher education has been generally accepted as influencing positively further employability, particularly when related with the study field (Blackwell et al., 2001; Helyer and Lee, 2014; Irwin et al., 2019) and when integrated in study programs (Kamaliah et al., 2018; Irwin et al., 2019; Jackson and Bridgstock, 2020). The literature has provided substantial evidence that practical experience represents an effective way to develop a sense of efficacy, enabling the application and articulation of knowledge and skills (Van Dinther et al, 2011; Monteiro et al., 2016; Jackson and Wilton, 2017), particularly in relation to the confidence in making applications and/or attending interviews, in demonstrating skills and strengths and taking career decisions (Edwards, 2014).

Work experiences also contribute to the development of a clearer understanding of the world of work and to gaining experience and skills (Beavis et al., 2005; Jackson and Wilton, 2017; Jackson and Bridgstock, 2020). However, such positive relationship seems to be not so linear when considering the case of worker students who have to conciliate academic and professional responsibilities. Such students might have less available time to invest in their academic work and in other activities that can proportionate career opportunities, comparing with "traditional" students (Osborne et al., 2004; Humphrey, 2006). In addition, research highlights that university students who have full-time jobs that do not correspond to the studies they are currently pursuing, can have lower academic achievement than their colleagues (Yanbarisova, 2015; Byrne, 2020;). For these reasons, despite the potential benefits that might derive from work experiences, in some specific circumstances, work experience can affect negatively students' perceptions of employability.

Academic achievement and perceived employability

Academic achievement has been considered a key variable for understanding different events that arise in higher education. For example, high academic achievement, is one of the variables that best explains academic progress and permanence in college (Esteban et al., 2017; Casanova et al., 2018; Ferrão and Almeida, 2018). Academic achievement appears to affect students' self-perception during their studies. Students with low performance levels perceive academic activities as not meaningful and valuable, and

are less motivated because their motivation tends to be extrinsic, have lower self-esteem and tend to make little effort (Martínez, 2009). Also students with positive academic self-perceptions were more likely to work hard and devote more time to their studies than students with negative academic self-perceptions (Meltzer et al., 2004).

Taking the perspective of university to work transition, new graduates with higher academic achievement have increased chances to be called for selection and recruitment processes and to obtain career rewards in terms of employment and salary (McKinney et al., 2003; Imose and Barber, 2015). Moreover, research examining the effect of academic achievement in perceived employability in business graduates have corroborated the positive relation between these two variables (Pinto and He, 2019; Pinto and Ramalheira, 2017; Tentama and Abdillah, 2019). Despite that, some authors have also argued that such positive relationship might not be linear and irrefutable, particularly in contexts or scientific areas where the job market demand is lower than the number of available graduates to work. For example, in a recent study with final-year graduates, Tomlinson (2018) concludes that despite students' recognition of academic credentials as a significant dimension for employability, students increasingly consider the importance to add value to those credentials. Therefore, the increased labor market competition seem to generate uncertainty about what students and new graduates can expect from higher education (Tymon, 2013; Clarke, 2018; Jorre de St Jorre and Oliver, 2018; Jackson and Tomlinson, 2020), and this can contribute to some devaluation of academic credentials, including academic achievement.

Educational experiences and perceived employability

Since the implementation of the European Higher Education Area (EHEA), European universities have found it necessary to work on the restructuring of their different curricula, seeking to respond to the demands of today's society, offering students and society in general a higher education system based on excellence (Villamizar et al., 2014). In order to achieve this purpose, the institutions have changed the teaching-learning approach in order to prepare students to face the labor market. Higher education, has to be able to train the students not only in the theoretical-practical contents of the career but also has to train students to adapt to the constant changes brought by the knowledge society given the quick expiration implicit in the training and information in this society (Gonzalez et al., 2016).

In addition, nowadays, universities are challenged with the task of training students in a series of transversal competencies that are key to both academic success and adaptation to the labor market. In this way, employers and employees highly value the ability to leadership, teamwork, communication skills, initiative and willingness to change, for example (Jato et al., 2016). Consequently, the success on social and labor market insertion will depend on proper basic training that allows to adapt the students' qualification to the labor market and their social and professional skills that configure the different job profiles. Therefore, it might be expected that positive educational experiences during higher education will be positively related with higher perceived employability by students. Employability is enabled by the construction of students' understandings from personal experience, combined with pedagogical approaches that promote learning and positive engagement (Knight and Yorke, 2002; Dacre Pool and Sewell, 2007; Bridgstock, 2009; Monteiro, Almeida et al., 2020). Several empirical studies have already demonstrated this positive impact of competencies development on perceived employability (Qenani et al., 2014; Alvarez et al., 2017), particularly when mediated by career management skills (Jackson and Bridgstock, 2020; Monteiro, Ferreira, et al., 2020).

Method

In this research we are particularly interested to develop previous research about student's perceptions of employability (García-Aracil et al., 2018), focusing mainly in work experience, academic achievement and educational experiences, and to explore how such perceptions are consistent with lecturers' perceptions about this process. For this purpose, a three-phases study has been carried out. In the first phase, a comprehensive assessment of the literature has been made. As a result of this, we have been able to define the evaluation model which describes the impact of three different factors on students' perceptions about their perceived preparation to the labor market - work experience, academic achievement and educational experience. Subsequently, in phase two, a survey was carried out among students at the University of Minho (Portugal) to find out their perception of these variables. These data were analysed with the software IBM SPSS Statistics (version 27.0). After that, in phase three, we incorporate lecturers' and experts in students employability perception through the use of a fuzzy hybrid Multi-criteria decision-making (MCDM) methods. In particular, we use fuzzy methodologies FAHP and

FTOPSIS to determine the importance of the different criteria that define the perception of employability.

A convenience sample of 641 students, 59% male and 41% female, was considered. Participants were in the final-year of their master courses, representing four different subject areas of a public university in north of Portugal: Economics (31%), Human and Social Sciences (27%), Law (11%) and Engineering (31%). The average mean was 25.71 years old ($SD = 6.81$). One hundred and eighty-two students (28.4%) reported already have had a work experience (study-related or not). Data was collected in classroom context taking near 20 minutes of class time. Previous contacts have been done with teachers of different scientific areas to permit taking their classes in order to obtain a heterogeneous sample. Participants completed the survey in pencil and paper, after having explained to them the objectives of the study and signing a free and informed consent form.

Three independent variables were expected to have a positive impact on students', described hereafter: *Work experience*, represented by a dichotomous item whereby students indicated if they have any type of paid professional activity, whether or not related to their field of study; *Academic achievement*, represented by the average academic achievement at the end of their degree (0 to 20 scale where 10 points starts a positive or passed classification); and *Educational experience*, represented by students' evaluation of their university education quality, in a 5 point Likert scale, taking for this purpose a set of ten competencies and knowledge domains: theoretical knowledge, practical knowledge, communication, methodological, interpersonal, participatory, organizational, socioemotional, generic and employability competencies. Scale unidimensionality was observed by Cronbach Coefficient Alpha (.863) and McDonald Omega coefficient (.864), as well as satisfactory adjustment to one factor model ($\chi^2/df = 6.62$; CFI = 0.909; TLI = 0.858; RMSEA = 0.094). In this study *employability perception* was assessed asking students about their preparation to the labour market. For that, a 5-point Likert item was used, through which participants indicated their overall preparation perception to the labour market.

Concerning lecturers' perceptions, an online meeting was scheduled with six higher education lecturers with experience in the preparation of undergraduates to work transitions, from different Portuguese Higher Education institutions. After an explanation of objectives and task, these lectures were enquired about the weight of each of the three factors theoretically identified as potentially relevant for students' perceived employability (academic achievement, work experience and educational experience). For this purpose, an evaluation matrix of these three criteria - C1: Academic achievement; C2: Work experience; C3: Educational experience - was presented for each participant to fill in, as represented in Figure 1.

Students' perception of preparation to the labour market																	
More important than								Equal	Less important than								
9 8 7 6 5 4 3 2								1	2 3 4 5 6 7 8 9								
C1																	C2
C1																	C3
C1																	C4

Figure 1. Evaluation matrix for evaluation of the three criteria.

Different methodologies were used to analyze lecturers' perceptions of the impact of those three independent variables on students' employability.

Multi-criteria decision-making (MCDM)

The multi-criteria decision-making theory approach has become an important means of providing real-time solutions to uncertainty problems (Stojic et al., 2019). MCDM is expressed as a decision-making method to establish the best alternative of a number of alternatives based on certain criteria (Santoso et al., 2019). The most common methods used in MCDM are Weighted sum model (WSM), Weighted product model (WPM), Compromise programming (CP), Analytical hierarchy process (AHP), Elimination and Choice Expressing Reality method (ELECTRE), Technique for Order of Preference by Similarity to Ideal Solution (TOPSIS), Preference ranking organization method for enrichment evaluation (PROMETHEE), Serbian Multicriteria Optimization and Compromise Solution (VlseKriterijuska optimizacija I komoromisno resenje, VIKOR), Weighted aggregated sum product

assessment (WASPAS), Multi-Attribute Utility Theory (MAUT) (Kabir et al., 2014; Bidoux et al., 2019; Sitorus et al., 2019). Usually, the multi-criteria decision-making methods are based on numerical scales (crisp data). However, the human preferences and judgments are often imprecise and vague. So, the use of linguistics assessments to describe the variables and the weights importance allow a better realistic approach thanks to artificial intelligent tools as Fuzzy Sets theory (Zadeh, 1965).

Fuzzy Analytic Hierarchy Process (FAHP)

AHP is one of the most common used methods in multi-objective decision making problems (Vaidya and Kumar, 2006; Mardani et al., 2015; Bunyan Unel and Yalpir, 2019) AHP methodology developed by Saaty (1980) allows for multi-criteria assessments in regard to decision making based on importance comparisons between the factors involved in the decision making (Saaty, 1996). Nevertheless, there is still weakness that AHP based decision making inevitably involves decision maker’s subjectivity in determining the preference for evaluation objectives (Kim et al., 2020). To solve this problem, Fuzzy AHP (FAHP) is proposed to address the issue of ambiguity and uncertainty resulting from this characteristic of AHP method. This methodology emerges as a combination of the traditional AHP (Saaty, 1980) with the fuzzy sets Theory (Zadeh, 1965). The use of FAHP highlighted the quality of this technique based on expert judgment (Bajic et al., 2020), being able to include the associated uncertainty in decision making, enabling to improve the consistency and flexibility of the results (Van Laarhoven and Pedrycz, 1983).

In order to maintain a strategy of distance to these assessments, a fuzzy model is created using Fuzzy AHP capable of providing more complete, adaptable and practical results (Meshram et al., 2019) to the proposed assessment model. The Fuzzy AHP method consists of four phases (Yu et al., 2011): (1) define the AHP structure; (2) establish the pair comparison matrix; (3) weight calculation for each criterion; and (4) consistence test.

To define the AHP structure for the multi criteria decision problem it is necessary to establish different steps (Albayrak and Erensal, 2004): (1) the goal to be achieved, (2) the criteria for the evaluation, and (3) the alternatives definition. Each criteria or alternative in the hierarchy can be broken down into explanatory elements, and as many as necessary should be used. Then, to establish the pair comparison matrix, which allows the decision maker to establish importance by comparing in pairs. In this point, the crisp values have been replaced by fuzzy values more adequate to natural language. The use of fuzzy values is more attractive, easier to use and more assimilable to real life than numerical ones (Ishizaka and Labib, 2011). Table 1 shows the Fuzzified Saaty’s nine-scale for triangular fuzzy number (Bajic et al., 2020; Kim et al., 2020).

Table 1
Fuzzy AHP scale

Linguistic variable	AHP Value	FAHP Scale
		Triangular Fuzzy Number ($0.5 \leq \alpha \leq 2$)
Equal	1	(1, 1, $1 + \alpha$)
Weak	3	($3 - \alpha$, 3, $3 + \alpha$)
Strong	5	($5 - \alpha$, 5, $5 + \alpha$)
Very strong	7	($7 - \alpha$, 7, $7 + \alpha$)
Absolute	9	($9 - \alpha$, 9, 9)
Intermediate values	2,4,6,8	($x - 1$, x, $x + 1$) $x = 2, 4, 6, 8$

To determine this consistency, Saaty (1980) defines the so-called consistency ratio for each of the matrices established in the previous phase. The consistency ratio (CR) is used to directly estimate the consistency of the comparison pairs and is expressed as indicate Eq. 1.

$$CR = \frac{CI}{RI}$$
 (1)

Where CI is the consistency coefficient and RI is the random index is calculated with Eq. 2, which indicates the consistency ratio of a random matrix, that confirm if the comparison is or not acceptable. Table developed by Saaty (1980) (Table 2) established a relationship between consistency ratios and the number of criteria used to analyze the proposed model.

$$CI = \frac{\lambda_{\max} - n}{n - 1} \quad (2)$$

Where $\lambda_{\max}$ is the maximum self-value and n is the dimension of the decision matrix.

Table 2

Consistency ratio

n	1	2	3	4	5	6	7	8	9	10
RI	0.00	0.00	0.58	0.90	1.12	1.24	1.32	1.41	1.45	1.49

Once the consistency has been calculated, the weights are obtained, which represent the relative importance of each criterion. To do this, the method of the self-values described in the following expression is used (see Eq. 3).

$$Aw = \lambda_{\max} w \quad (3)$$

Where A represents the comparison matrix, w the autovector or preference vector, and $\lambda_{\max}$ the autovalue. Later, once the weights have been calculated and the consistency of the assessments confirmed. Finally, defuzzified each consistent expert's judgement using the Converting the Fuzzy data into Crisp Scores (CFCS) method (Opricovic and Tzeng, 2003), calculate integrate crisp matrix, and final weights (Nazari-Shirkouhi et al., 2017).

FTOPSIS method

TOPSIS methodology developed by Hwang and Yoon (1981), seeks to order the alternative solutions to a problem according to preferences for similarity to an ideal solution (ranking method). According to this methodology, the best alternative must have two characteristics: be the closest to the positive ideal solution and the farthest from the negative ideal solution (Chen et al., 2006). The FTOPSIS method consist on three steps: (1) fuzzy variation matrix for each criterion; (2) standardized and Weighted Decision Matrix; and (3) closeness coefficients for each alternative and ranking. The first step is to calculate the fuzzy valuation matrix of the criteria. In this regard, C_i ($i=1 \dots n$) are the evaluation criteria and A_j ($j=1 \dots m$) are the alternatives solution to be ranked. The fuzzy decision matrix has the structure presented in Eq.4.

$$[\tilde{D}_x] = \begin{matrix} & \begin{matrix} C_1 & C_2 & \dots & C_j & \dots & C_n \end{matrix} \\ \begin{matrix} A_1 \\ A_2 \\ \dots \\ A_i \\ \dots \\ A_m \end{matrix} & \begin{pmatrix} \tilde{x}_{11} & \tilde{x}_{12} & \dots & \dots & \dots & \tilde{x}_{1n} \\ \tilde{x}_{21} & \tilde{x}_{22} & \dots & \dots & \dots & \tilde{x}_{2n} \\ \dots & \dots & \dots & \dots & \dots & \dots \\ \dots & \dots & \dots & \tilde{x}_{ij} & \dots & \dots \\ \dots & \dots & \dots & \dots & \dots & \dots \\ \tilde{x}_{m1} & \tilde{x}_{m2} & \dots & \dots & \dots & \tilde{x}_{mn} \end{pmatrix} \end{matrix} \quad (4)$$

Where $\tilde{x}_{ij}$ be the fuzzy valuation of criterion “j” in the alternative “i” –a consensual triangular fuzzy number for that valuation-: $\tilde{x}_{ij} = (x_{ij1}, x_{ij2}, x_{ij3})$.

Later, in order to establish the standardised and weighted decision matrix, a homogenisation has to be carried out to measurement the criteria in the interval $[0, 1]$ in line with the Eq. 5.

$$\tilde{x}_{ij}^* = \frac{\tilde{x}_{ij}}{\max_j(x_{ij3})} = \left(\frac{x_{ij1}}{\max_j(x_{ij3})}, \frac{x_{ij2}}{\max_j(x_{ij3})}, \frac{x_{ij3}}{\max_j(x_{ij3})} \right) = (x_{ij1}^*, x_{ij2}^*, x_{ij3}^*) \quad (5)$$

The fuzzy weight of each criteria $\tilde{W}_j = (w_{j1}, w_{j2}, w_{j3})$ is calculated by accord. In this case we use the pairwise comparison obtained the previous FAHP method. Then, the standardized elements and weighted decision matrix are calculated according to Eq. 6.

$$\tilde{v}_{ij} = \tilde{W}_j * \tilde{x}_{ij}^* = (w_{j1} * x_{ij1}^*, w_{j2} * x_{ij2}^*, w_{j3} * x_{ij3}^*) \quad i = 1, 2, \dots, m; j = 1, 2, \dots, n \quad (6)$$

Afterwards, in order to calculate the closeness coefficients for each alternative and stablish the ranking, the fuzzy positive (A^+) and negative (A^-) ideal solution chose the optimum fuzzy value from all alternatives for each criterion, liable on their nature (benefit criteria “Cb” or cost criteria “Cc”) such illustrate Eq. 7 and Eq. 8.

$$A^+ = \{\tilde{v}_1^+, \tilde{v}_2^+, \dots, \tilde{v}_n^+\} \quad \wedge \quad \tilde{v}_j^+ = \begin{cases} \max_i \tilde{v}_{ij}, & \text{if } j \in Cb \\ \min_i \tilde{v}_{ij}, & \text{if } j \in Cc \end{cases} \quad i = 1, 2, \dots, m; j = 1, 2, \dots, n \quad (7)$$

$$A^- = \{\tilde{v}_1^-, \tilde{v}_2^-, \dots, \tilde{v}_n^-\} \quad \wedge \quad \tilde{v}_j^- = \begin{cases} \min_i \tilde{v}_{ij}, & \text{if } j \in Cb \\ \max_i \tilde{v}_{ij}, & \text{if } j \in Cc \end{cases} \quad i = 1, 2, \dots, m; \quad j = 1, 2, \dots, n \quad (8)$$

By using benefit criteria, real numbers “1” and “0” are usually chosen – in their fuzzy representation -, to express the components of A^+ and A^- respectively (see Eq. 9):

$$\tilde{v}_j^+ = (1, 1, 1); \quad \tilde{v}_j^- = (0, 0, 0); \quad \forall j = 1, 2, \dots, n. \quad (9)$$

Then, positive and negative distances to the ideal solution are calculated according equations (10) and (11) from each alternative to the positive and negative ideal solutions can be calculated by using equations (9), where $d(\tilde{v}_{ij}, \tilde{v}_j^+)$ is the distance among these fuzzy numbers.

$$d_i^+ = \sum_{j=1}^n d(\tilde{v}_{ij}, \tilde{v}_j^+) \quad i = 1, 2, \dots, m; \quad j = 1, 2, \dots, n. \quad (10)$$

$$d_i^- = \sum_{j=1}^n d(\tilde{v}_{ij}, \tilde{v}_j^-) \quad i = 1, 2, \dots, m; \quad j = 1, 2, \dots, n. \quad (11)$$

The final step is to calculate the closeness coefficient of each alternative “ i ” according with the equation (12) in order to establish the ranking of the alternatives.

$$CC_i = \frac{d_i^-}{d_i^- + d_i^+} \quad \forall i = 1, 2, \dots, m \quad (12)$$

Results

Starting with students’ results, Table 3 presents the descriptive statistics of the variables that compose the model evaluated. The results indicate that overall students’ perceptions of their preparation to the labour market are positive, although slightly lower than their perceptions about educational experience during higher education studies. Students’ academic achievement is in average positive, scoring 14 point in 0-20 points scale. The majority of the participants reported having already had some kind of professional experience. Measures of skewness and kurtosis were well within accepted ranges of -2 and 2 (George and Mallery, 2010).

Table 3
Descriptive Statistics of the variables of the validation model.

Variables		M	SD	Kurtosis	Skewness
Preparation to the labour market (1-5 points)		3.34	.84	-.364	.126
Academic achievement (0-20 points)		14.19	1.54	-.068	-.548
Educational experience (1-5 points)		3.63	.55	-.366	.109
N (%)					
Work experience	Yes (1)	384 (60.1%)			
	No (2)	255 (39.9%)			

Results obtained from the linear regression analysis are presented in Table 4. These data confirm that educational experience is a significant predictor of students’ perceptions of preparation to the labour market. The variable that measure work experiences is close to, although not reaching significant values for the explanation of the criterion variable. In turn, academic achievement did not show any significant effect on the explanation of preparation to the labour market. Adjusted R^2 of .269 indicates reasonable model fit and the model is significant ($F(3, 557) = 69.608, p < .000$).

Table 4
Regression analysis with predictors of preparation to the labour market.

Predictor	B	SE	β	p value
Academic achievement	-0.027	0.020	-0.049	.176
Educational experience	0.434	0.030	0.518	.000**
Work experiences	-0.116	0.061	-0.069	.060
R^2				0.273
Adjusted R^2				0.269

Table 5 shows an example for one expert evaluation and the importance weights of each criteria in the model that analyses the students' perception of their preparation for the job market.

Table 5

Example of pair-wise comparison matrix between criteria (C).

	C1	C2	C3	Wi
C1: Academic achievement	1	2	9	0.595
C2: Work Experience	0.5	1	7	0.347
C3: Educational experience	0.11	0,14	1	0.058

As we can see in Table 5, the most important criteria for this expert in the employability perception, it is the academic achievement (0.595), following by work experience (0.347) and, finally, educational experience (0.058). Table 6 represents the results with the weights of each three criteria by six lecturers, assumed as experts.

Table 6

Weights results for each criteria (C) and expert (Exp).

	Exp1	Exp2	Exp3	Exp4	Exp5	Exp6
C1: Academic achievement	0.220	0.164	0.087	0.595	0.230	0.595
C2: Work Experience	0.713	0.297	0.750	0.347	0.122	0.347
C3: Educational experience	0.067	0.539	0.162	0.058	0.648	0.058

Results suggest the experts' 4 and 6 consider the academic achievement variable has the highest relevance for students' employability perceptions, and the expert 3 considers it less important than another. On the other hand, the work experience variable, in general has a good evaluation, especially for the expert 3 that consider the most important variable in the proposed model. Lastly, the educational experience variable has lower values, except for expert 5 that consider that this variable is important in the employment perception model. As we can see, there are different evaluations and each expert assumes different importance weights for each variable in the model. In order to homogenise this information, an aggregation of the results was made in terms of weights and consistency coefficients for this model that analyses the students' perception of their preparation for the job market. Table 7 shows the results of such aggregation.

Table 7

Aggregated results in terms of weights and consistence

	Weights	Index		
C1: Academic achievement	0.366	CI	RI	CR
C2: Work experience	0.484	0.001	0.525	0.002
C3: Educational experience	0.150	¿Consistence (CR<0.05)? Yes		

The consistency ratio (CR) of each pair-wise comparison judgment matrices is lower than 0.05. The experts' results aggregation allows to establish that the importance weight for each variable are consistent. As a result, it can be confirmed that the most important variable for the experts is Work experience (0.484), followed by Academic achievement (0.484) and finally, Educational experience (0.150).

After validating the individual and aggregated consistency of the results, the weights from this aggregation will be used to indicate the relevance of each criterion in the evaluation model in the next phase with the F-TOPSIS methodology. F-TOPSIS method allows to establish a ranking of the best study fields perceived by the students in terms of employability. Firstly, we introduce the weights results obtained in the previous AHP method. Later, to sort the four criteria according to their importance, it is necessary to defuzzified their values and order them decreasingly. Table 8 presents the importance weight of each criterion obtained. *The results confirm that Educational experience is the most important variable for the experts (BNP=0.632), followed by Work Experience (BNP=0.247), and Academic achievement (BNP=0.153), respectively.*

Table 8
Fuzzy importance weights and BNP for the considered criteria

Criteria	Crisp weight	Fuzzy importance weights (TFN)			BNP	Weights Ranking
	W	W ₁	W ₂	W ₃		
C1: Educational experience	0.366	0.52	0.61	0.76	0.632	1
C2: Academic achievement	0.484	0.00	0.06	0.40	0.153	3
C3: Work Experience	0.150	0.01	0.33	0.40	0.247	2

Comparing the assessments of the three factors associated with employability by the students and the expert teachers (Table 4 and Table 8), some differences can be pointed out. Educational experience is the factor more determinant for students but the last in teachers' hierarchy. Lecturers assume the work experience as the most relevant factor for students' employability. Differences in ages and roles may explain these values. Adults seem to value previous work experiences, while younger people recognize a greater relevance of transversal skills in the jobs available today. On the other hand, teachers may not value educational experience because is related to activities that compete with their classes and competences more related to the curriculum.

Conclusions

Students' perceptions assume relevance on graduate employability and preparation for labor market transition (Yorke and Knight, 2004; Dacre Pool and Sewell, 2007; Bridgstock, 2009). In addition to understanding how students perceive themselves in terms of their employability it is important to explore how lecturers perceive such development of employability too (Jackson and Wilton, 2017; Ayllón et al., 2019; Dieste et al., 2019).

In the literature three variables can be considered as influent on students' employability perceptions and labor market transition: academic achievement, previous work experience and educational experience (Helyer and Lee, 2014; Esteban et al., 2017; Irwin et al., 2019; Jackson and Bridgstock, 2020). Nowadays, their relevance increases face the labor market competition and uncertainty (Clarke, 2018; Jorre de St Jorre and Oliver, 2018; Jackson and Tomlinson, 2020). In this context, Higher Education must assure an educational experience not reduced to the theoretical-practical contents of a profession. Several authors defend academic experience must include the development of transversal competencies like leadership, teamwork, communication skills, initiative or critical thinking, for example (Gonzalez et al., 2016; Jato et al., 2016; Monteiro et al., 2020). Recent research shows an important impact of those competencies development on students' perceived employability (Qenani et al., 2014; Alvarez et al., 2017; Jackson and Bridgstock, 2020; Monteiro, Ferreira, et al., 2020).

Regression analysis on students' perceived employability suggest a significant contribution of academic achievement, previous work experience and educational experience, explaining 27% of employability perception variance. The analysis of each variable impact shows the educational experience assume almost all variance explained. Previous work experience is near a significant contribution ($p = .06$) and academic achievement did not show significant impact. These data are quite different of lecturers' perceptions, where work experience assumes the main effect and educational experience the last place (academic achievement is in middle position). It is interesting to verify that students give high importance to educational experience which do not correspond to lecturers' opinions, while previous work experience and academic achievement assume more relevance for lecturers. This discrepancy between students and lectures in the hierarchy of the contribution of the three factors to the graduates' employability justifies further deepening. Above all, the discrepancy observed in terms of educational experience, placed first by students and last by lectures, may reflect a clarity on the part of students about the relevance of transversal skills for employability face to knowledge and competencies confined to the curriculum (Tomlinson, 2008), while teachers may assume that the investment of time and energy by students in those activities that develop soft skills can be competitive and reduces student involvement in formal learning of scientific skills.

Some limitations can be introduced, perhaps the lack of significance of work experience from students perspective can be related to the presence in this sample of older and workers students with a full-time job, which can reduce the quality of their educational experience and, particularly when this professional activity is in a field not related to the scientific area of graduation (Yanbarisova, 2015;

Irwin et al., 2019; Byrne, 2020; Jackson and Bridgstock, 2020). So, in future, those analyses must consider different students subgroups in function of stratified samples by age and work experience, or scientific area of graduation.

Recognizing institutions and lectures' role on students' employability perceptions and preparation to work market transition, it is important to analyze the reasons of the discrepancies between lecturers and students. The identification of those reasons assumes institutional relevance, for example to introduce changes in the curriculum plans and innovation practices on teaching and learning processes, in order to assure deeper involvement of students in their vocational decisions and career taking the variables more relevant in self-perception employability.

Nevertheless, studying these subjective variables is not an easy task in a multi-criteria decision problem. For this reason, in this work, we include the Fuzzy Inference Systems in order to reduce the subjectivity inherent in multi-criteria decision-making processes. In this way, we have been able to take into account the opinion of experts and students who have established their assessments in a natural language more adapted to the human way of thinking. Therefore, the results obtained in this work allow us to incorporate the uncertainty inherent in the decision-making processes and therefore optimize the results.

References

- Alvarez, P., López Miguens, M.J., and Caballero, G. (2017). "Perceived employability in university students: developing an integrated model". *Career Development International*, 22(3), 280–299.
- Ayllón, S., Alsina, Á., and Colomer, J. (2019). "Teachers' involvement and students' self-efficacy: Keys to achievement in higher education". *PLOS ONE*, 14(5), e0216865.
- Beavis, A., Curtis, D., and Curtis, N. (2005). *What do students know about work? Senior secondary school students' perceptions of the world of work*. The Smith Family.
- Bennett, D., and Ananthram, S. (2021). "Development, validation and deployment of the EmployABILITY scale". *Studies in Higher Education*, 1888079.
- Bernardo, A., Esteban, M., Cervero, A., Cerezo, R., and Herrero, F.J. (2019) "The influence of self-regulation behaviors on university students' intentions of persistence". *Frontiers in Psychology*. 10:2284.
- Bhopal, K., Myers, M., and Pitkin, C. (2020). "Routes through higher education: BME students and the development of a 'specialisation of consciousness'". *British Educational Research Journal*, 46, 1321-1337.
- Blackwell, A., Bowes, L., Harvey, L., Hesketh, A.J., and Knight, P. (2001). "Transforming work experience in Higher Education". *British Education*, 27(3), 269–285.
- Bridgstock, R. (2009). "The graduate attributes we've overlooked: Enhancing graduate employability through career management skills". *Higher Education Research and Development*, 28(1), 31–44.
- Byrne, C. (2020). "What determines perceived graduate employability? Exploring the effects of personal characteristics, academic achievements and graduate skills in a survey experiment". *Studies in Higher Education*, 1–18.
- Carney, C., McNeish, S., and McColl, J. (2005). "The impact of part time employment on students' health and academic achievement: a Scottish perspective". *Journal of Further and Higher Education*, 29(4), 307-319.
- Casanova, J.R., Cervero, A., Núñez, J.C., Almeida, L.S., and Bernardo, A. (2018). "Factors that determine the persistence and dropout of university students". *Psicothema*, 30(4), 408–414.
- Centeno-Moreno, G., and Cubo-Delgado, S. (2013). "Evaluación de la competencia digital y las actitudes hacia las TIC del alumnado universitario". *Revista de Investigación Educativa*, 31(2), 517-536.
- Chadha, D., and Toner, J. (2017). "Focusing in on employability: Using content analysis to explore the employability discourse in UK and USA Universities". *International Journal of Educational Technology in Higher Education*, 14(1), 1–26.
- Clarke, M. (2018). Rethinking graduate employability: the role of capital, individual attributes and context. *Studies in Higher Education*, 43(11), 1923–1937.
- Dacre Pool, L., and Sewell, P. (2007). "The key to employability: developing a practical model of graduate employability". *Education + Training*, 49(4), 277–289.
- Dieste, S.A., Rapún López, M., and Romero-Martín, M.R. (2019). "Percepciones de estudiantes universitarios sobre una evaluación formativa en el trabajo en equipo". *Revista Iberoamericana de Evaluación Educativa*, 12(1), 175-192.

- Donald, W. E., Baruch, Y., and Ashleigh, M. (2017). "The undergraduate self-perception of employability: human capital, careers advice, and career ownership". *Studies in Higher Education*, 44(4), 599-614
- Dumitriu, C., Timofti, L.C., and Dumitriu, G. (2014). "Communicative skill and/or communication competence?". *Procedia-Social and Behavioral Sciences*, 141, 489-493.
- Edwards, M. (2014). "The impact of placements on students' self-efficacy". *Higher Education, Skills and Work-Based Learning*, 4(3), 228-241.
- Eliška, K. (2016). "Risk factors of young graduates in the competitive E.U. labor market at the end of the current economic crisis". *Journal of Competitiveness*, 7(3), 38-51.
- Esteban, M., Bernardo, A.B., Tuero, E., Cervero, A., and Casanova, J. (2017). "Variables influyentes en progreso académico y permanencia en la universidad". *European Journal of Education and Psychology*, 10, 75-81.
- Fernández-Fassnacht, E. (2017). "Una mirada a los desafíos de la educación superior en México". *Journal Educational Innovation*, 12(74), 183-207.
- García-Aracil, A., Monteiro, S., and Almeida, L.S. (2018). "Students' perceptions of their preparedness for transition to work after graduation". *Active Learning in Higher Education*, 1-14.
- George, D., and Mallery, P. (2010). *SPSS for Windows Step by Step: A Simple Guide and Reference 17.0 Update*. (10th Edition (ed.)).
- González-Lorente, C., and Martínez-Clares, P.M. (2016). "Expectativas de futuro laboral del universitario de hoy: un estudio internacional". *Revista de Investigación Educativa*, 34(1), 167-183.
- Grosemans, I., and De Cuyper, N. (2021). "Career competencies in the transition from higher education to the labor market: Examining developmental trajectories". *Journal of Vocational Behavior*, 128, 103602.
- Guarini M.R., Battisti F., and Chiovitti, A. (2021). "A methodology for the selection of multi-criteria decision analysis methods in real estate and land management processes". *Sustainability*. 10, 507.
- Habets, O., Stoffers, J., Van der Heijden, B., and Peters, P (2020). "Am I Fit for Tomorrow's Labor Market? The Effect of Graduates' Skills Development during Higher Education for the 21st Century's Labor Market". *Sustainability*. 12(18), 7746.
- Helyer, R., and Lee, D. (2014). "The Role of Work Experience in the Future Employability of Higher Education Graduates". *Higher Education Quarterly*, 68(3), 348-372.
- Holford, A. (2020). "Youth employment, academic achievement and labour market outcomes: Production functions and policy effects". *Labour Economics*, 63.
- Humphrey, R. (2006). "Pulling structured inequality into higher education: The impact of part-time working on English university students". *Higher Education Quarterly*, 60(3), 270-286.
- Imose, R., and Barber, L.K. (2015). "Using undergraduate grade point average as a selection tool: A synthesis of the literature". *The Psychologist-Manager Journal*, 18(1), 1-11.
- Irwin, A., Nordmann, E., and Simms, K. (2019). Stakeholder perception of student employability: does the duration, type and location of work experience matter? *Higher Education*, 78(5), 761-781.
- Izquierdo-Rus, T., and Farias-Gragmena, A. J. (2018). "Employability and achievement expectation on job placement of the university students". *Revista Española de Orientación y Psicopedagogía*, 29(1), 29-40.
- Jackson, D., and Bridgstock, R. (2020). "What actually works to enhance graduate employability? The relative value of curricular, co-curricular, and extra-curricular learning and paid work". *Higher Education*. 81(4), pp.723-739
- Jackson, D., and Tomlinson, M. (2020). "Investigating the relationship between career planning, proactivity and employability perceptions among higher education students in uncertain labour market conditions". *Higher Education*, 80(3), 435-455.
- Jackson, D., and Wilton, N. (2017). "Perceived employability among undergraduates and the importance of career self-management, work experience and individual characteristics". *Higher Education Research and Development*, 36(4), 747-762.
- Jato-Seijas, E., Cajide-Val, J., Muñoz-Cadavid, M.A., and García-Antelo, B. (2016). "La formación del profesorado universitario en competencias lifelong learning a partir de las demandas de empleadores y egresados". *Revista de Investigación Educativa*, 34(1), 69-85.
- Jianu, M.R., and Grecea, C. (2020). "Student support in the transition from higher education to labor market. 14th International Technology", *Education and Development Conference (INTED)*, 7912-79.

- Jorre de St Jorre, T., and Oliver, B. (2018). "Want students to engage? Contextualise graduate learning outcomes and assess for employability". *Higher Education Research and Development*, 37(1), 44–57.
- Jurado-Santos, P., Olmos-Rueda, P., and Pérez-Romero, A. (2015). "Los jóvenes en situación de vulnerabilidad y los programas formativos de transición al mundo del trabajo". *Educar*, 51(1), 211–224.
- Kamaliah, S., Roslan, S., Bakar, A.R., and Ghiami, Z. (2018). "The effect of supervised work experience on the acquisition of employability skills among Malaysian students". *Higher Education, Skills and Work-Based Learning*, 8(4), 354–364.
- Kessler, G. (2010). "La disyunción educación-trabajo en el Mercosur. Coincidencias y diferencias entre jóvenes de Argentina, Brasil, Paraguay y Uruguay". *Revista Propuesta Educativa*, 2(34), 53–64.
- Knight, P., and Yorke, M. (2002). "Employability through the curriculum". *Tertiary Education and Management*, 8(4), 261–276.
- López-Angulo, Y., Pérez-Villalobos, M.V., Bernardo, A.B., Cobo-Rendón, R., Sáez-Delgado, F., and Díaz-Mujica, A. (2021). "Propiedades psicométricas de la Escala Multidimensional de Apoyo Social Percibido en estudiantes universitarios". *Revista Iberoamericana de Diagnóstico y Evaluación e Avaliação Psicológica*, 58(1), 127–140.
- Mckinney, A.P., Carlson, K.D., Mechan, R.L., D'Angelo, N.C., and Connerley, M.L. (2003). "Recruiters' use of GPA in initial screening decisions: Higher GPAs don't always make the cut". *Personnel Psychology*, 56(4), 823–845.
- Meltzer, L., Reddy, R., Pollica, L.S., Roditi, B., Sayer, J., and Theokas, C. (2004). "Positive and negative self-perceptions: is there a cyclical relationship between teachers' and students' perceptions of effort, strategy use, and academic achievement?". *Learning Disabilities Research and Practice*, 19(1), 33–44.
- Milner, S., Cousins, W., and McGowan, I. (2016). "Does all work and no play make a dull graduate? Perceptions of extra-curricular activities and employability". *Journal of Perspectives in Applied Academic Practice*, 4(1), 13–18.
- Monteiro, S., Almeida, L. S., and García-Aracil, A. (2016). "Graduates' perceptions of competencies and preparation for labour market transition: The effect of gender and work experience during higher education". *Higher Education, Skills and Work-Based Learning*, 6(2), 208–220.
- Monteiro, S., Almeida, L.S., and García-Aracil, A. (2020). "It's a very different world": Transition to work and perceived employability of Higher Education graduates". *Higher Education, Skills and Work-Based Learning*, 11(1), 164–181.
- Monteiro, S., Ferreira, J.A., and Almeida, L.S. (2020). "Self-perceived competency and self-perceived employability in higher education: the mediating role of career adaptability". *Journal of Further and Higher Education*, 44(3), 408–422.
- Osborne, M., Marks, A., and Turner, E. (2004). "Becoming a mature student: How adult applicants weigh the advantages and disadvantages of higher education". *Higher Education*, 48(3), 291–315.
- Pavlin, S. (2020). "Who makes higher education graduates ready for work? The case of teacher education in Slovenia". *European Journal of Education*, 55(4), 489–500.
- Pérez, R., Mercado, P., Martínez, M., Mena, E., and Partida, J.Á. (2018). "La sociedad del conocimiento y la sociedad de la información como la piedra angular en la innovación tecnológica educativa". *Revista Iberoamericana para la Investigación y el Desarrollo Educativo*, 8(16), 847–870.
- Pérez-Padilla, H. (2015). "Expectativas, satisfacción y rendimiento académico en alumnado universitario". *Revista de Psicología y Educación*, 10(1), 11–32.
- Perusso A., and Wagenaar, R. (2021). "The state of work-based learning development in EU higher education: learnings from the WEXHE project". *Studies in Higher Education*, 1904233.
- Pinto, L.H., and He, K. (2019). 'In the eyes of the beholder': the influence of academic performance and extracurricular activities on the perceived employability of Chinese business graduates". *Asia Pacific Journal of Human Resources*, 57(4), 503–527.
- Pinto, L.H., and Ramalheira, D.C. (2017). "Perceived employability of business graduates: The effect of academic performance and extracurricular activities". *Journal of Vocational Behavior*, 99, 165–178.

Qenani, E., MacDougall, N., and Sexton, C. (2014). "An empirical study of self-perceived employability: Improving the prospects for student employment success in an uncertain environment". *Active Learning in Higher Education*, 15(3), 199–213.

Rothwell, A., Herbert, I., and Rothwell, F. (2008). "Self-perceived employability: Construction and initial validation of a scale for university students". *Journal of Vocational Behavior*, 73(1), 1–12.

Tentama, F., and Abdillah, M.H. (2019). "Student employability examined from academic achievement and self-concept". *International Journal of Evaluation and Research in Education*, 8(2), 243.

Tomlinson, M. (2008). 'The degree is not enough': Students' perceptions of the role of higher education credentials for graduate work and employability. *British Journal of Sociology of Education*, 29(1), 49–61. <https://doi.org/10.1080/01425690701737457>

Turner, N.K. (2014). "Development of self-belief for employability in higher education: ability, efficacy and control in context". *Teaching in Higher Education*, 19(6), 592–602.

Tymon, A. (2013). "The student perspective on employability". *Studies in Higher Education*, 38(6), 841–856.

Van Dinther, M., Dochy, F., and Segers, M. (2011). "Factors affecting students' self-efficacy in higher education". *Educational Research Review*, 6(2), 95–108.

Vargas, R., Sánchez-Queija, M. I., Rothwell, A., and Parra, A. (2018). "Self-perceived employability in Spain". *Education and Training*, 60(3), 226–237.

Villamizar, G., Becerra, D.R., and Martínez, A.C. (2014). "Autopercepción de estudiantes de psicología sobre sus competencias en los campos laboral, educativo y salud". *Revista de Estudios y Experiencias en Educación*, 13(26), 151-167.

Wittekind, A., Raeder, S., and Grote, G. (2010). "A longitudinal study of determinants of perceived employability". *Journal of Organizational Behavior*, 31(4), 566–586.

Wolff, R., and Booth, M. (2017). "Bridging the gap: Creating a new approach for assuring 21st century employability skills". *Change: The Magazine of Higher Learning*, 49(6), 51-54.

Yanbarisova, D.M. (2015). "The Effects of Student Employment on Academic Performance in Tatarstan Higher Education Institutions". *Russian Education and Society*, 57(6), 459–482.

Yannis, G., Kopsacheili, A., Dragomanovits A., and Petraki, V. (2020). "State-of-the-art review on multi-criteria decision-making in the transport sector", *Journal of Traffic and Transportation Engineering*, 7(4),413-431.

Yorke, M., and Knight, P. (2004). *Embedding employability into the curriculum. Learning and Employability Series 1*. Higher Education Academy.