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The Influence of Gender and Age on the Open-Mindedness of University Students

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Abstract: Open-mindedness (OM) is one of the select groups of 21st-century soft skills that are lacking in the university curricula. Our aim was to analyse the OM level of our university students and study the influence of gender and age on OM. To do so, we used an ex post facto experimental design, a snowball sampling technique, an OM questionnaire administered to 493 students and statistical techniques of data mining and multiple linear regression. The results show medium–low levels of OM and higher scores in those below 49 years of age and female gender. The variable that most influenced the variability of OM was age (82%), compared to gender (18%). The practical implications of these results aim to promote a more inclusive, active and higher-quality university education that integrates OM, together with other competencies, to make our students more competitive academically and favour their entry into the labour market.

Keywords: open-mindedness; higher education; soft skills; gender; age

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1. Introduction

The Bologna Plan called for Higher Education to be based on professional competencies; however, the deficit in the implementation of this learning [1] and the generalised tendency to maintain traditional methods within the university teaching–learning process has limited the fulfilment of this objective [2]. In response to this need, models of transversal competencies were created, such as the Tuning Education Structures in Europe Project [3], which have served as a reference for change. Aguado [4] studied the relationship between these competencies (instrumental, interpersonal and systemic) and personality variables assessed using the Big Five Questionnaire (BFQ) [5], including Open-Mindedness (OM). OM correlated positively with 18 of these 26 competencies, hence our interest in this research.

OM is considered one of the habits of mind of the critical thinker [6]. Critical thinking (CT) and, by extension, OM, our variable of study, are part of a select group of soft, socio-emotional or 21st-century skills that have gained great relevance in the last decade and are considered an asset in today's society and labour market [7]. The Youth Employment Funders Group defines them as a set of skills, attitudes, behaviours and personal qualities that enable people to relate to their context, work well with others and achieve their goals [8] and prepare them to not only adapt to change but also to anticipate and manage it [9].

OM predisposes the individual to analyse the environment in a broader and more global way, implies adaptability in facing new challenges [10] and contributes to thinking outside the box [11]; therefore, it is not surprising that it correlates positively with creativity, divergent thinking and cognitive flexibility [12–15]. People with low OM tend to refrain from trying new things, have a closed, literal mindset and enjoy routines [16]. People with high OM perform best in tasks that require information absorption or the innovative use of knowledge [17].

Innovation, creativity and OM are competencies demanded by organisations and should be worked on at university [18]. The global education in which we are immersed

needs this critical and open mentality [19] that OM implies. Prior research has recommended explicit CT instruction to impact students' CT effectively. However, they have had little influence in practice [7].

It is in our interest that our university students are competent, well informed and open-minded, flexible and fair when it comes to reasoning, able to tolerate divergent positions and change their minds if the evidence justifies it [20], diligent in generating ideas, adopting positions and proposing new alternatives and arguing for actions in different situations and problems [21–23] in order to respond to the academic–professional demands that life places on them.

In this sense, the Organisation for Economic Cooperation and Development (OECD) has included OM ("Openness to Experience") in its "Big Five Skills" model, together with "Meticulousness/Diligence" (task performance), "Emotional Stability" (emotional regulation), "Extraversion" (involvement with others) and "Agreeableness" (collaboration). The OECD [24] defines OM as the willingness of individuals to consider other perspectives or try new experiences and includes within it three sub-skills, curiosity, tolerance and creativity, which need to be developed, in their opinion, taking into account that OM, as such, is a predictor of educational attainment, is positively related to school performance, has positive lifelong benefits and seems to equip individuals to cope better with change.

Recent meta-analyses indicate that these specific personality traits predict a range of organisational and individual outcomes related to overall job performance. Factor five (OM) has been the most commonly used taxonomy in these meta-analyses. The only situation in which OM appears to have high predictive validity is in jobs that involve cooperative personal interaction and helping and caring for others. Employees with high OM are intellectual, creative, curious, have broad interests, are willing to participate in learning experiences and are better able to concentrate on the task at hand and produce higher-quality work, thereby promoting behaviours that produce the desired outcome [25].

Further elaborating on the term, OM has been identified as a strength and as a personality factor. As a cognitive strength, it is classified under "wisdom and knowledge" [26] along with others such as creativity, curiosity, love of learning and perspective. It involves, according to [27], the ability to change one's point of view; thinking about things and examine all meanings and nuances; fostering respect for and appreciation of other ways of thinking and acting; and the willingness to actively seek evidence and evaluate it fairly and impartially. All of these skills are essential for academic and professional success.

As one of the five personality factors, OM has been conceptualised as "Openness to culture" [28], "Intellect" [29], "Openness to experience" [30] or "Openness/intellect" [10]. In our study, we considered it "Openness/Intellect", which implies the ability of individuals to adapt to novelty without fear of learning and demonstrating fluid intelligence [16]. Authors such as Caprara et al. [5] define it using adjectives such as innovative, imaginative, creative, inventive and clever and include in it the ability to innovate and see the same thing from different perspectives.

In relation to the social sphere, individuals with OM tend to be empathetic [31], in addition to having a broad vision of society's values, styles or ways of life without falling into conventionalism. They are tolerant and understanding and do not judge other people's lifestyles, norms, cultural groups or behaviour [32]. They possess initiative and are motivated towards learning [33]. They are able to adapt to novel situations and have social and intrapersonal skills that they handle intelligently in any situation. This self-awareness allows them to confidently hold their own opinions, implying greater autonomy and CT as skills that will lead them to greater psychological well-being in relation to their life purposes [34]. Hence, OM, together with other personality factors, is positively related to positive coping styles, beneficial for the prevention of mental health disorders [35,36].

Some authors have even shown that OM is the only one of the five personality factors related to intelligence [10], hence the additional interest in investigating its positive relationship with academic performance [37]. Taking all the above into account, it seems that an individual with high OM would possess both cognitive and socio-emotional competen-

cies that could facilitate their personal, academic, social and professional success, and as Barcelata et al. [35,38] and Urquijo et al. [34] point out, also their well-being. Hence our interest in analysing OM and promoting its progressive development in the educational environment in general and in the university environment in particular.

As for its measurement, OM has been commonly assessed as a personality variable, together with other factors, with the NEO-FFI questionnaire by Costa and McCrae [30] or the BFQ by Caprara et al. [5]. Both tests have a long history in the field of empirical research due to their high reliability and validity; however, their excessive length may promote fatigue and, thus, difficulty in administration [16]. Hence, new lines of research have emerged that have provided shorter questionnaires, such as the FIPI [39], the SIMP [40], the BFI-10 [41], the CBP [16] or the QQATCT [42], among others. In the present research, we used the Openness/Intellect items of Torreblanca's brief personality questionnaire (CBP) due to its adaptation to the language, its good psychometric properties, easy administration, simplicity and similarity in terms of factorial structure to the BFQ, one of the most widely used instruments for the measurement of this type of variables. There are no precedents of research that have used OM as an independent factor, hence the novelty and need for this type of study.

Some antecedents that have evaluated OM as a personality factor, along with others in university students like ours, have found medium–low levels in this variable [37,43–46], with only a small percentage (15.8%) presenting high scores in this factor [47]. When the OM variable has been measured as a character strength, medium levels have also been found [48], which indicates that working towards its development is a challenge that we must address at the university.

When we asked ourselves which variables could influence OM, we found from Cardenal and Fierro [49] that sex and age are "the objective individual characteristics most clearly associated with psychological variables (. . .). However, not much is known about them (. . .). It does not seem to be biological sex, but the social role ascribed to it, i.e., gender, that is associated with personality dispositions" (p. 118). "The findings concerning individual differences according to sex have a limited socio-cultural scope of validity (. . .), it makes perfect sense to find out what these differences are and how they are shaped" (p. 119). This conditioned our choice of gender and age as individual variables that can influence OM as a personality factor.

Reviewing the literature on gender, we find that differences in OM are not always evident [24]. With university students, the authors of [47,50–52] found significant differences in OM in favour of females, with a small effect size (Cohen's d between 0.13 and 0.412). Other authors, such as Caballo et al. [53], obtained slightly higher mean scores in females, but the differences were not significant. However, authors such as [54–56] found significant differences in favour of the male gender, with a small effect size (with Cohen's d between 0.22 and 0.477). Finally, other authors, such as Alvear [37,43,49,57–61], found slightly higher mean scores in males, but the differences were not significant. Studies of gender differences in OM in university students therefore provide inconclusive data. More research is needed in this area.

In relation to age differences in OM of university students, the results are also contradictory. Authors such as [47,62] found significant differences in favour of older students (>25 years) compared to younger ones (<25 years), with a small effect size (d = 0.255). In some facets of OM, such as ideas and values, those over 50 years old obtained the highest scores [55]. In contrast, studies with large populations and different cultures have concluded that OM occurs mainly in younger people [50,55], with a small effect size (d of 0.443 and 0.23, respectively). Longitudinal research showed decreasing openness to experience with age [49]. Recent studies, however, have found no significant differences by age [58,61], which invites further exploration along these lines.

Bearing in mind the importance and need for soft skills such as OM in university education, as we have argued, the absence of studies that have examined it independently

of other personality traits or strengths, and the heterogeneity of results found in the different studies referred to, we proposed the following research objectives:

- To find the OM of the university students in our sample.
- To describe the profile of the student with high/low OM.
- To determine the influence of personal variables (like gender and age) on OM.

2. Method

The research methodology was non-experimental or ex post facto [63], descriptive and cross-sectional.

2.1. Participants

Practical and accessibility reasons arising from the COVID-19 pandemic conditioned the use of non-probability snowball sampling. This type of sampling is useful for sample cases that are difficult to access, where the sample size needs to be expanded and the explanatory scope of the data needs to be improved [64]. It is one of the most common methodological strategies for these cases [65] and suitable for qualitative, exploratory and descriptive studies and situations where there are geographical limitations and a cost of administration [66]. To overcome the limitations of this segmented sampling, we conducted an ethnographic assessment of the initial sample to identify any networks that might exist between it and the given population. The initial subgroup was treated as a cluster to reduce coverage bias [67]. In order to improve the external validity of non-probability samples, we combined the snowball technique with a controlled selection system, where the initial subjects, students who, during the 2020–2021 academic year, were in their first year of the Bachelor's Degree in Early Childhood and Primary Education at our university, were recruited from other related subjects with similar characteristics until an acceptable sample size was achieved [66]. Finally, we employed online administration and data collection techniques that encouraged participation.

To ensure the accuracy of our estimates or statistical hypothesis testing, we calculated the sample size needed for a predictive model [68]. Table 1 shows the results of the statistics used.

Table 1. Statistics for sample size calculation.

U	f^2	Sig.	Power
2	0.02	0.05	0.80

Note: *U* = number of variables; f^2 = effect size in linear regression models.

The f^2 was estimated considering the theoretical effect sizes (Cohen's *d*) found in the reviewed literature on differences in OM by gender and age, already referred to in our introduction, which, in all cases, were small. We did not find any joint study of OM by gender and age like ours, so we studied the effect sizes of each predictor variable separately. The minimum necessary sample obtained was 475 students, which was sufficient in our case, considering that we exceeded this figure by 18 students (n = 493).

We also calculated the sampling error assumed with the final sample [69]. Having also verified its suitability in this aspect (4.41% error, with a confidence level of 95%) [70], we proceeded to the statistical treatment of the data.

The final sample consisted of 493 undergraduate Social Sciences/Legal students: 373 (75.7%) from public and 120 (24.3%) from private universities; 115 (23.3%) males and 378 (76.7%) females; aged 18–70 years (M = 29.93, SD = 10.721); and a mean professional experience of 5.69 (SD = 8.74) years.

2.2. Instruments

To assess OM, we used items 5, 10, 15 and 20 corresponding to factor V, "Openness and Intellect" (Table 2) of the Brief Personality Questionnaire developed by Torreblanca [16], of

only 20 items, using a Likert-type scale with 5 response options, which measures 5 major personality factors and 2 sub-dimensions for each factor: Factor I, Sociability and Salience; Factor II, Empathy and Warmth; Factor III, Speed and Order; Factor IV, Anxiety and Depression; and Factor V, Openness and Intellect, and present adequate psychometric properties ($\alpha = 0.75$). In this test, the primary factor weights for Openness/Intellect were 0.88–0.91 ($M = 0.89$), the secondary weights ranged from 0 to 0.18 ($M = 0.07$) and the reliability was acceptable ($\alpha = 0.73$) [71]. In our study, the value achieved was adequate ($\alpha = 0.779$). Regarding validity, in the original scale, the five factors presented moderate to good convergent correlations, and the concurrent validity of this factor (OM) with the corresponding factor of the BFQ of Caprara et al. [5], called "Openness to Experience", was good ($\alpha = 0.865$) [72].

Table 2. Items from factor V, "Openness and Intellect" administered.

Items
5. I like to try new things
10. I do not like logic problems.
15. I prefer the familiar to the new
20. I like intellectual challenges

2.3. Data Collection and Analysis Procedures

The test was developed in Google Forms and administered online by the research team in the usual virtual classroom. The instructions made explicit the objective of the research, as well as guaranteeing the anonymity of the answers and the confidentiality of the data for exclusive use for the purposes of the research, in accordance with Organic Law 3/2018 on the Protection of Personal Data and Guarantee of Digital Rights and the General Data Protection Regulation (EU) 2016/679.

Following the ethical standards of the Declaration of Helsinki [73], prior to completion, students gave their self-informed consent and agreed to participate voluntarily in the study, with the request and commitment on their part that, once the test was completed, they would forward it to other university students with similar characteristics to their own, to ensure compliance with the established snowball sample selection procedure. Participation in the test remained open for five months. The data were then tabulated, cleaned, and statistically processed.

We applied descriptive statistics (frequencies, percentages, means, standard deviations, maximum and minimum scores) to out the characteristics of the sample and its level of OM.

To describe the profile of students with high/low OM and determine which variables (predictors) explained changes in this dependent variable, the decision tree data mining technique was used, along with CART (Classification And Regression Trees) a growth method, which allows for binary partitioning and is the most accurate and comprehensive procedure to generate and validate predictive-explanatory models [74], taking into account that it orders variables according to their importance in predicting the dependent variable [75]. To evaluate the decision tree, the root mean square error (RMSE) was used, interpreting values close to 0 as low prediction error [76].

The multiple linear regression technique was performed by entering the possible predictor variables in the order of the previous technique. Before interpreting the coefficients, goodness-of-fit and predictive model assumptions were assessed. For the former, the *F*-test was used, which indicated that the linear relationship was statistically significant. For the second, following the indications of Pardo and San Martín [77], the assumptions of non-collinearity, linearity, independence of errors, homoscedasticity of the residuals and normality, as well as the influence of outliers, were assessed. The assumption of non-collinearity was checked with the variance inflation factor (values below 10 indicated that there was no collinearity problem). The linearity assumption was estimated with second- and third-order polynomial regressions, concluding that, if the variables are not significant, the predictors were linearly related to the response variable. The assumption

of independence of the errors was calculated with the Durbin–Watson statistic, considering that values between 1.5 and 2.5 reaffirmed this independence. The homoscedasticity assumption was established with scatter plots of the forecasts and residuals to check that the populations had the same variance. The Breusch–Pagan test was used to check the homogeneity of the residuals. Finally, the normality assumption was estimated using the Anderson–Darling statistic and Q-Q plots of residuals. In all models, the assumptions were met, except for normality. The influence of outliers was tested using Cook's distance. As the value obtained was less than 1, it was concluded that there was no influential case [78].

To see the contribution of the personal variables on OM, the adjusted R^2 and the effect size of the model was calculated using the f^2 statistic, which was interpreted with Cohen's [79] criteria: very small (<0.02), small (0.02–0.14), medium (0.15–0.34) and large (>0.35). The statistical power of the regression analysis was estimated with values above 80% optimal. To determine the individual contribution of each predictor, the average R^2 statistic was used [80].

Finally, as the assumption of normality was not met, to refine our results, we applied non-parametric statistics to assess differences between groups (Mann–Whitney *U* for gender and Kruskal–Wallis *H* for age, with Bonferroni correction) and better interpret our results; we also computed quantile regression on the main (Q25, Q50 and Q75) ranges of the OM score distribution.

For the statistical treatment of the data, we used the *R* program, version 4.2.0; for the sample size and statistical power of the predictive models, the *pwr* package; for the assumptions of normality, *nortest*; for homoscedasticity, *lmtest*; for linearity, multicollinearity and independence of errors, *car*; and for the relative importance of the explanatory variables, *relaimpo*. In all cases, we worked with statistical significance levels of $\alpha = 0.05$ and, in some particular cases, $\alpha = 0.01$.

3. Results

3.1. Open-Mindedness of University Students

To find the OM of the students, we calculated the descriptive variables for this variable. The OM reached a minimum value of 4 and a maximum of 14, with the mean level of the students being 9.42 (*SD* = 1.56). To improve the interpretation of our results and to adapt them to specific scales for our sample, we converted our direct scores to centiles. OM's mean score occupied a centile position of 47.2, which allowed us to interpret that our students have a medium–low ability to be informed, to acquire knowledge, to be interested in things, to adapt to and cope with new situations and to consider each reality from different perspectives.

3.2. Profile of the Open-Minded Learner

To describe the profile of students with OM, we made decision trees. In Figure 1, we observe that the lowest OM score is found in students aged 49 years and older (*M* = 8.3), 9% of the total sample, while the highest OM score is found in students under 49 years of age (*M* = 9.5), 91% of the total sample, the majority (70%) of whom are women (*M* = 9.6), compared to 21% who are men (*M* = 9.2) of the same age. The prediction error for these estimates was 1.506 (small) [76], which gives explanatory power to the result achieved.

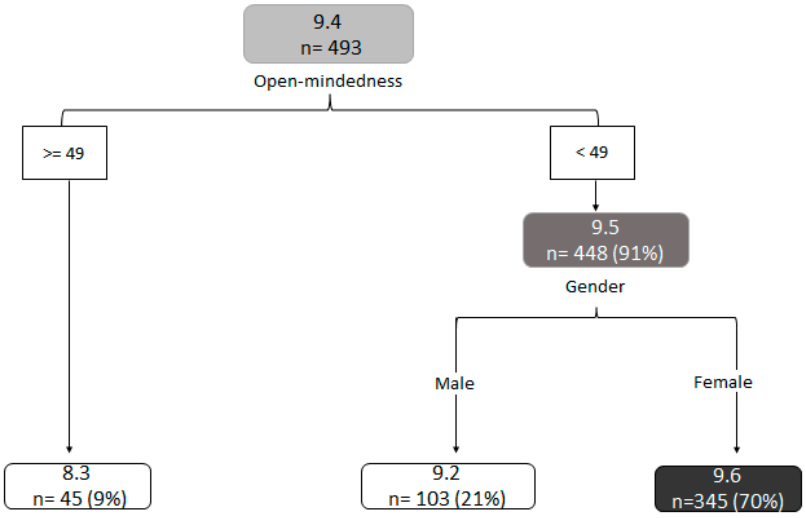

Figure 1. Profile of the open-minded learner.

3.3. Influence of Gender and Age on Open-Mindedness

To refine the percentage explanation that age and gender give us of students' OM obtained with the decision tree, a multiple linear regression model was carried out. Table 3 shows the final model.

Table 3. Regression statistics for open-mindedness.

	B (SE)	Significance
Constant	10.079 (0.251) ***	
Age	−0.030 (0.006) ***	0.822
Gender	0.315 (0.163)	0.178
R^2 adjusted	0.050	
f^2	0.057	
RMSE	1.515	
Statistical power	99%	
AIC	1816.704	

Note: *** $p < 0.001$.

In the model obtained, the joint variance of age and gender explained 5.02% of the variability of the OM. Age, specifically, had a relative importance within it of 82.2%, and gender, 17.8%. The effect size ($f^2 = 0.057$) was small [79] but of high statistical power (99%).

Analyses of OM mean differences showed statistical significance by gender (*UM-W* = 18044.5, $p = 0.005$) and by age (*HK-W* = 23.891, $p < 0.001$). By gender, females ($M = 9.52$, $SD = 1.594$) showed higher OM scores than males ($M = 9.11$, $SD = 1.4$). In the comparisons of OM means by pairs of age groups, in Figure 2, we see that only those for the 51–61 years age group versus 29–39 years age group achieved statistical significance ($H = 90.41$, $p = 0.004$) and those corresponding to the 51–61 years group versus 18–28 years group ($H = 107.91$, $p < 0.001$), in favour, in both cases, of the younger students ($M_{18–28} = 9.62$, $SD = 1.507$; $M_{29–39} = 9.43$, $SD = 1.488$; $M_{51–61} = 8.25$, $SD = 1.822$). In Figure 3, we observe that OM scores have their lowest mean at 51–60 years of age, rising progressively in the following age range.

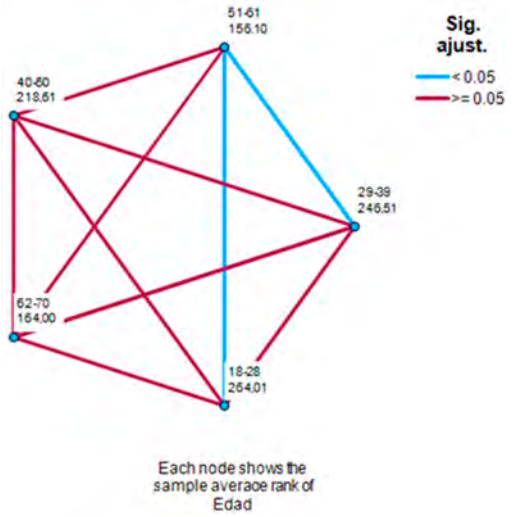

Figure 2. Statistical significance of comparisons of open-minded means by age (Edad)−pairs.

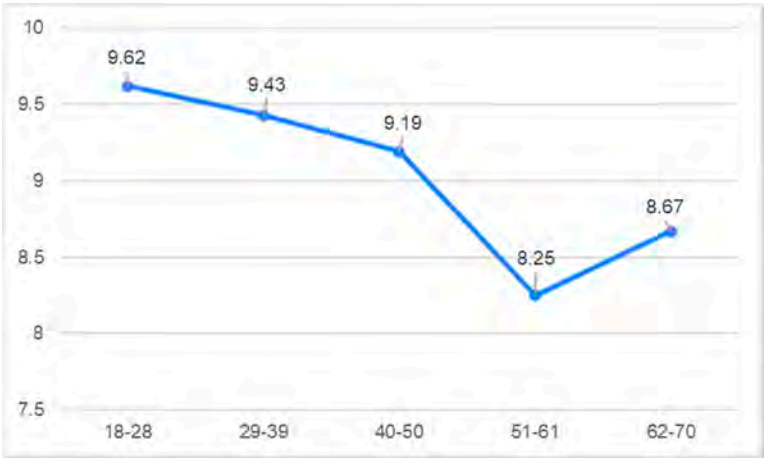

Figure 3. Open−minded mean scores by age groups.

If we look at the *Beta* coefficients (Table 2) of the two variables introduced in the predictive model (gender and age), only age was statistically significant ($p < 0.001$), which confirms its greater explanatory power for OM. The negative sign of the coefficient indicates that the older the age, the lower the OM. For each additional year of the student, the OM decreases by 0.030 points.

To refine these results and be even more precise, we computed the quantile regression on the main (Q25, Q50 and Q75) brackets of the OM score distribution (Table 4).

Table 4. Estimation of the relationship of personal variables and OM. Quantile regression.

	Q25	Q50	Q75
Constant	8.5 (0.538) ***	9.2 (0.376) ***	10.03 (0.535) ***
Age	−0.029 (0.009) **	−0.028 (0.006) ***	−0.312 (0.009) **
Gender (female)	0.529 (0.237) *	0.657 (0.165) ***	0.812 (0.235) **
Pseudo R^2	0.030	0.027	0.037
AIC	1915.808	1838.548	1920.801

Note. *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$.

As can be seen (Table 3), age is statistically significant in all main distributions, with a negative direction, supporting the result that the older the age, the lower the OM.

Gender is also a statistically significant variable in all main distributions, but in this case, with a positive direction, indicating that women have higher OM than men.

In relation to the contribution to the model (Pseudo R^2), the 75th percentile is highest, followed by the 25th and 50th percentiles, indicating that the personal variables (age and gender) as a whole have the greatest impact on students with high OM. The best fitting of the two models used (multiple and quantile) in our predictions of OM from the personal variables considered was the multiple regression model.

4. Discussion, Conclusions and Prospective

Our study set out to find the OM level of the participating university students, describe the high/low profile in this variable and determine the influence of personal variables on OM to promote higher-quality education. This psychology of individual differences is practical and useful for individuals [49] and for education professionals in that it facilitates more precise interventions aligned with the demand for this competence at university.

The data indicate that the OM of our sample is medium–low, in line with those of other authors such as [37,43–46,48], which increases the need to work on developing OM at university.

By gender, we found significant differences in Openness/Intellect in favour of women, in line with other researchers such as [47,50–52]. And although gender differences have not been shown to be a predictor of open-mindedness [81], we need to promote more inclusive and equitable education in university in the development of this variable.

By age, OM scores are highest in the youngest group in our study (<49 years), in line with the findings of authors such as [49,50,55], and decrease significantly with increasing age [81–84], until a critical point of decline at the age of 51–61 years, in which more cognitive than emotional traits may predominate [85], and interest in the new decreases, the mind becomes more conservative and seeks more security, to increase later, between 62 and 70 years of age, a stage in which the mind becomes more curious again, open to experience and new intellectual challenges, curious and flexible. This should be taken into account in the development of a university education that considers the peculiarities derived from age, making the most of the potential of the younger generations in Openness, motivating older and more conservative students towards more OM, and highlighting the potential of the older students in Intellect, based on their greater life experience, and as a complement to the lesser life experience of the younger students.

Future research could compensate for the limitations of this study related to the selection of participants (despite our control of sampling error and the adequacy of our sample to ensure the accuracy of our results) with larger and more representative random samples stratified by variables such as knowledge area, geographical area, ethnicity, etc., which could provide an overview of possible differences in OM, which is important for the development of critical thinking.

Another line of research could be aimed at improving the reliability and validity of short OM instruments such as ours, contrasting our results, improving the accuracy of the measurement with different populations and taking into account individual differences such as those we have proposed in this study. In this sense, authors such as Manassero-Mas et al. [42] recommend brief and viable tools that facilitate educational interventions to develop this type of competencies from elementary educational stages. Advancing multifaceted measures representative of OM at its different levels of abstraction (facet, aspect and global trait) and its effects would be a new field yet to be explored [86–88].

Similarly, it would be interesting to propose experimental pre-test/post-test designs with experimental and control groups, testing interventions for the development of OM in university classrooms, which could be complemented with qualitative studies based on observations or discussion groups, in which the main groups of interest (management teams, teachers and students) would be represented in order to plan, systematise and

evaluate actions to improve the quality of education at the University, in line with current demands for educational change, and in order to meet the needs of a labour market that is increasingly changing and demanding in terms of the training of university graduates who seek employment.

Finally, the research carried out could also be enriched and overcome its limitations with surveys of how university students' OM can influence and be influenced by multi-faceted factors such as creativity, entrepreneurship, emotional intelligence, critical thinking, leadership, learning styles, multiple intelligences, academic performance, self-efficacy and resilience, among others, identified as necessary and essential competencies of the 21st century [8], and be studied from different multi-perspectives, as suggested by authors such as Boonsathirakul and Kerdsomboon [89].

In the context of university education, we have long advocated for the development of these transversal competencies that are so in demand in global society [3,19] and by organisations [18,25] and are indispensable for health and well-being [34,35,38] and for success in studies [37], work and life [24,90,91].

Predictive models are needed to anticipate individual critical thinking skills [92] and effective practices [7] based on empirical data to guide professionals in their effective development in the classroom and in other social and work contexts where their application is necessary. Our results point towards an inclusive, more active and higher-quality university education, as we have suggested in previous works [93], which integrates OM together with other professional competencies, making our students more competitive academically and professionally and favouring their insertion in the labour market.

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Data Availability Statement: The data are available from the corresponding author upon request.

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