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Sociodemographic differences in critical thinking among Spanish university students

Diferencias sociodemográficas en el pensamiento crítico del estudiantado universitario español

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Abstract

This study investigates critical thinking capacity among Spanish university students considering sociodemographic factors. Employing a quantitative approach, we used an exploratory, non-experimental, cross-sectional ex post facto design. A total of 5,238 students participated in the study and were assessed through closed-ended survey questions. Findings indicate that, although students demonstrate high levels of critical thinking, additional training is necessary to further enhance their skill. Moreover, significant differences are observed concerning sociodemographic factors such as gender, region, university type, and field of study. Male students and those enrolled in public universities and in-house centres (as opposed to affiliated centres) show higher levels of critical thinking, while students in the disciplines of Social Sciences and law display lower levels. Additionally, the universities with the highest levels of critical thinking are the Universitat de Barcelona, Universidad Carlos III de Madrid, and Universidade da Coruña. The study concludes by discussing its limitations and suggesting future research directions to foster a better understanding of critical thinking within the Spanish university context.

Keywords: critical thinking; university students; measurement; assessment.

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Resumen

Este estudio analiza el nivel de pensamiento crítico en el estudiantado universitario español, considerando variables sociodemográficas. Para ello, se realiza un estudio de carácter cuantitativo, adoptando un diseño de tipo no experimental transeccional exploratorio y ex post facto. En concreto, se evalúan 5.238 estudiantes mediante un cuestionario con preguntas cerradas. Los resultados muestran que, aunque el estudiantado presenta niveles elevados de pensamiento crítico, se requiere formación adicional para mejorarlo. Además, se encuentran diferencias significativas según variables sociodemográficas, como género, región, tipo de universidad y área de conocimiento. Los estudiantes hombres y quienes estudian en universidades públicas y centros propios muestran niveles más altos de pensamiento crítico, mientras que el estudiantado de Ciencias sociales y jurídicas presenta niveles más bajos. Asimismo, las universidades con los niveles más altos de pensamiento crítico son la Universitat de Barcelona, la Universidad Carlos III de Madrid y la Universidade da Coruña. El estudio concluye con la discusión de las limitaciones y sugiere futuras líneas de investigación para mejorar la comprensión del pensamiento crítico en el ámbito universitario español.

Palabras clave: pensamiento crítico; estudiante universitario; medición; evaluación.

Introduction

Critical thinking is a fundamental competence in higher education and increasingly important in a changing and globalised world (Jaswal and Behera, 2024; Prat-Sala and van Duuren, 2022). Contemporary challenges, such as climate change, political polarisation, conspiracy theories, the digital divide and rapid technological advances, demand an engaged and critical citizenry capable of addressing these issues in an informed, reflective and ethical manner (Aktoprak and Hursen, 2022; Barczak, 2022). In this sense, the university has a responsibility to contribute to the construction of a more just and sustainable society, equipping students with the skills, attitudes and knowledge necessary to assume a leading role as agents of change and leadership in social progress.

Although the inclusion of critical thinking in university curricula is common, its definition, teaching and assessment often lack specificity, making it the Cheshire Cat of education (Ellerton, 2015). In this regard, despite the growing importance of critical thinking and the willingness of faculty to teach it (Green, 2015), several obstacles remain, such as a lack of clarity in its definition (Hatcher and Possin, 2020), a shortage of resources and teacher training (Archila et al., 2022; Schendel et al., 2023), and a lack of appropriate assessment tools for university students (O'Leary et al., 2020). Furthermore, most of the evaluation studies available in the academic literature focus on the effectiveness of educational interventions in limited classroom groups, which prevents the generalisation of results to other educational contexts and to the student population as a whole.

In recent years, several research groups have made significant efforts to promote and evaluate critical thinking among students. Abrami and colleagues (Abrami et al., 2008, 2015) conducted the most comprehensive and widely cited meta-analysis on teaching critical thinking, concluding that the opportunity for dialogue, exposure of students to authentic problems and examples, and mentoring have positive effects on critical thinking skills.

Recently, at the international level, Johnston et al. (2023) investigated differences in critical thinking skills between secondary school students enrolled in the International Baccalaureate and those enrolled in national curricula in Australia, England and Norway. They identified that certain elements of the curriculum, such as explicitly integrating critical thinking into curriculum objectives or the use of inquiry-based methods, could positively influence levels of critical thinking.

At the national level, professors Rivas and Saiz, from the University of Salamanca, have led research on critical thinking at the Spanish university level over the last decade, developed programmes to promote this competence (Rivas and Saiz, 2023) and identified the role of critical thinking in predicting and improving academic performance (Rivas et al., 2023). However, to date, no national study has been conducted at the Spanish university level that assesses students' critical thinking, taking into account socio-demographic variables. Moreover, the lack of an objective and accessible instrument to measure critical thinking among university students in Spain makes it difficult to identify differences in the development of this competence. Therefore, this study aims to assess the level of critical thinking of university students in Spain and to determine possible significant differences in its level in relation to sociodemographic variables. The results of this work can provide valuable information for the design of personalised educational programmes adapted to the needs of students and universities, which will contribute to fostering a more equitable and inclusive university education.

Theoretical basis

Critical thinking is a complex and holistic cognitive process that aims to explore a statement or problem in order to reach a valid conclusion or choice of the alternative with the highest probability of success (Dwyer, 2017; Ennis, 1985; Halpern, 2014). To achieve this requires applying cognitive skills in an organised, disciplined and cautious manner, and operating according to rational standards (Ennis, 2018). In addition, the dispositional dimension of critical thinking is composed of attitudes that contribute to overcoming the cognitive biases inherent in the human mind, such as confirmation bias, and acting more ethically and fairly (Paul and Elder, 2019).

To cultivate critical thinking, it is essential to have a set of skills and the knowledge to apply them effectively, as well as the willingness to do so (Dwyer, 2017). Although the thinking process is fluid and continuous, its understanding, teaching and assessment can

benefit from the classification of skills into two main dimensions: analysis and evaluation of arguments, and problem solving (Table 1).

Table 1

Critical Thinking Model

Dimensions	Sub-dimensions
Analysis and evaluation of arguments	Analysis of arguments: Identification and analysis of arguments Content identification and analysis Identification and analysis of relationships Evaluation of arguments: Passive evaluation Active evaluation
Troubleshooting	[Phase 1] Problem identification and analysis [Phase 2] Identification of the strategy and alternative [Phase 3] Strategy-led action [Phase 4] Final evaluation

The *Argument Analysis and Evaluation* dimension is divided into two interdependent sub-dimensions: Analysis, which involves breaking down and examining the elements of an argument, and Argument Evaluation, which involves critically assessing the soundness and coherence of the argument as a whole (Andrews, 2015; Chatfield, 2022; Serementa et al., 2024). *Problem solving*, on the other hand, involves recognising and resolving difficulties logically and systematically (Aktoprak and Hursen, 2022; Southworth, 2022).

The *argument analysis* subdimension refers to the skills needed to detect, identify and examine the different parts of an argument, their relationships and the integrating principle. Some skills in this category include argument detection (Archila et al., 2022), discrimination between fact and opinion (Heard et al., 2020), and identification of the logical relationship between premise and conclusion (Eemeren and Henkemans, 2016). *Argument evaluation, on* the other hand, aims to estimate, independently of the level of agreement with the conclusion, the strength or weakness with which the premise supports this conclusion. This dimension also includes the rejection of statements that promote the violation of human rights, such as humiliation, discrimination or offence. This category includes specific skills such as assessing the credibility of information (Marttunen et al., 2021), identifying fallacies related to relevance, such as the use of an inappropriate source, and identifying false causal relationships (Cottrell, 2011).

As for the dimension of *problem solving*, in this paper, from a cognitive psychological perspective, it is defined as a mental process consisting of four phases: (a) identification and analysis of the problem (Bransford and Stein, 1993; Dwyer, 2017), (b) identification of strategies and alternatives (Halpern, 2014; Polya, 1945), (c) strategy-guided action

(OECD, 2017; Shanta and Wells, 2020), and (d) final evaluation (Bransford and Stein, 1993; Shavelson et al., 2019). Accordingly, problem-solving skills include identifying the basic elements of the problem (Dwyer, 2017), analysing its characteristics (Shanta and Wells, 2020) and the knowledge requirements necessary for its adequate resolution (García-Ruiz et al., 2020), choosing the best alternative solution (Halpern, 2014), implementing and taking corrective actions when necessary (OECD, 2017), and critically evaluating both the outcome and the procedure (Shavelson et al., 2019), among other aspects.

Method

Design

In order to achieve the objectives set out, a quantitative study was carried out, adopting a non-experimental, exploratory, transectional, ex post facto, non-experimental design.

Participants

The sample used is composed of 5,238 university students who volunteered to participate in the study, out of a total population of 1,340,632 university students in Spain, according to data published by the Government of Spain in 2022. It is important to note that the sample was selected using a non-probabilistic convenience sampling method.

The results of the study show that the majority of students are female (Table 2). In addition, the majority of students are studying a degree, and the distribution by year shows that half of them are in their first or fourth year. In terms of branches of knowledge, the most representative is Social and Legal Sciences, followed by Sciences, Engineering and Architecture, Health Sciences and, finally, Arts and Humanities. In terms of academic qualifications, the majority of students obtained a grade of "Notable", followed by "Good", "Excellent", "Sufficient" and "Insufficient".

Table 2

Description of the sample according to the subjects' socio-demographic variables

		N	%
Gender	Woman	3.151	60,15%
	Man	1.961	37,44%
	Non-binary people	126	3,41%
Study typology	Grade	4.728	90,26%
	Double degree	503	9,60%

Course	1º	1.577	30,11%
	2º	928	17,72%
	3º	652	12,45%
	4º	1.848	35,28%
	5º	212	4,05%
	6º	21	0,4%
Branch of knowledge	Social and legal sciences	1.601	30,57%
	Science	1.110	21,19%
	Engineering and Architecture	877	16,74%
	Health Sciences	829	15,83%
	Arts and Humanities	725	13,84%
	Mixed	96	1,83%
Transcript of records	IN (0-4)	15	0,29%
	SU (5)	84	1,60%
	BI (6)	1.007	19,22%
	NT (7-8)	2.221	42,40%
	SB (9-10)	333	6,36%
	No data (first year students)	1.578	30,113%

Note: No data were recorded for first-year students because their university academic record covers less than one academic year.

With regard to the variables related to the university, Table 3 shows a list of the 26 universities with the highest participation rate, which represent 82.67% of the total number of universities that took part in the study. The Complutense University of Madrid registered the highest participation rate, followed by the University of Oviedo, the University of the Basque Country and the University of Valencia. The majority of the students came from their own centres, public universities and face-to-face centres.

Table 3

Description of the sample in terms of the university variable

		N	**%**
University	U. Complutense de Madrid	532	10,16%
	U. of Oviedo	368	7,03%
	Euskal Herriko Unibertsitatea (University of the Basque Country)	287	5,48%
	U. of Valencia	251	4,79%
	U. de les Illes Balears	235	4,49%
	U. of Santiago de Compostela	221	4,22%
	U. Carlos III of Madrid	220	4,20%
	U. Polytechnic University of Valencia	205	3,91%
	U. of Malaga	166	3,17%
	U. of Granada	163	3,11%

	U. de La Laguna	148	2,83%
	U. of Seville	143	2,73%
	U. of Barcelona	143	2,73%
	U. Politécnica de Madrid	142	2,71%
	U. of Salamanca	130	2,48%
	U. Oberta de Catalunya	114	2,18%
	U. Pablo de Olavide	112	2,14%
	U. of Almeria	93	1,78%
	U. of Valladolid	91	1,74%
	U. Autónoma de Madrid	88	1,68%
Type of centre	Own centre	5.042	96,26%
	Affiliated centre	192	3,67%
Ownership of centre	Public U.	4.959	94,67%
	Private U.	273	5,21%
Format	In person	5.080	96,98%
	Online	152	2,90%

As for the geographical distribution of the sample used, all of Spain's autonomous communities were represented, with a higher percentage of participation in Madrid, Andalusia, Valencia and Catalonia (Table 4).

Table 4

Description of the sample according to the regional variable

		N	%
Autonomous Community	Madrid (Community of)	1.148	21,92%
	Andalusia	841	16,06%
	Valencian Community	617	11,78%
	Catalonia	493	9,41%
	Galicia	384	7,33%
	Asturias (Principality of)	368	7,03%
	Castilla y León	321	6,13%
	Basque Country	297	5,67%
	Balears (Illes)	235	4,49%
	Canary Islands	221	4,22%
	Aragon	76	1,45%
	Castilla La-Mancha	70	1,34%
	Cantabria	52	0,99%
	Murcia (Region of)	29	0,55%
	Navarra (Comunidad Foral de)	28	0,53%

State University (UNED)	27	0,52%
Rioja (La)	16	0,31%
Extremadura	15	0,29%

Instrument

In order to achieve the proposed objectives, an *ad hoc* data collection instrument was designed and developed through a rigorous multi-stage procedure. First, a comprehensive literature review was conducted and a sound theoretical model was constructed to support the validity of the instrument. Subsequently, attributes reflecting the construct were selected, and a system of dimensions, sub-dimensions and indicators was developed based on the theoretical underpinning. This system was reviewed by nine national and international experts in critical thinking, argumentation theory, problem solving, measurement and data analysis.

Thirdly, the content of the items was delineated according to the previously identified indicators. To this end, a variety of current and socially controversial topics were used to assess the ability to analyse and evaluate arguments in the first dimension of the instrument, while in the second dimension, areas in which university students often make decisions were chosen to assess their problem-solving skills.

A preliminary instrument, consisting of open-ended items, was designed and completed by 99 Spanish university students. Based on the analysis of the responses using advanced natural language processing techniques, including *Part of Speech Tagging* (POS Tagging), *Bag of Words* (BOW), and a linguistic model of sentiment analysis based on *Transformers*, the final instrument, called *CritiTest*, was designed. Thus, the final instrument consisted of a total of 108 items with a 5-grade Likert-type response. The results showed good internal consistency, with a Cronbach's alpha coefficient of 0.86 for the full scale, and values of 0.81 and 0.76 for the dimensions of *analysis and evaluation of arguments* and *problem solving*, respectively (see table 5).

Table 5

Overall and dimensional reliability quotient

Dimensions	Sub-dimensions	Cronbach's Alpha	N items
Analysis and evaluation of arguments	Analysis of arguments Identification and analysis of arguments Content identification and analysis Identification and analysis of relationships Evaluation of arguments Passive evaluation Active evaluation	0,81	73

Troubleshooting	[Phase 1] Problem identification and analysis [Phase 2] Identification of the strategy and alternative [Phase 3] Strategy-led action [Phase 4] Final evaluation	0,76	35
TOTAL		0,86	108

The validity of the instrument is justified by the procedures described above. These are: theoretical foundation, expert judgement and analysis of the results of the pilot study. Firstly, the content validity is justified by the theoretical foundation on which the critical thinking model is based. This literature review justifies the inclusion of the following dimensions: *analysis and evaluation of arguments* and *problem solving*. Secondly, an expert judgement is carried out. Specifically, there are 9 national and international experts from different domains: measurement, critical thinking, analysis and evaluation of arguments and problem solving. Finally, a pilot study is conducted and the results are analysed through sophisticated analysis methods that include statistical and content analysis through natural language processing, i.e. through *machine learning* technology that allows to interpret and understand human language.

Procedure

For the application of the instrument, contact was made with the main heads of all Spanish universities, including rectors, vice-rectors, deans, vice-deans, teaching staff and student representatives, requesting their collaboration in the collection of data via an online platform. Those who showed interest in participating were provided with a virtual version of the instrument for distribution to their students in the 2021/2022 academic year.

Before completing the instrument, students were informed that their participation was voluntary and that they could withdraw at any time without consequence. They were also assured that their responses would be anonymous and confidential, used for research purposes only. In this regard, they were notified that the data would be processed in accordance with Regulation (EU) 2016/679 of the European Parliament and of the Council of 27 April 2016, as well as Organic Law 3/2018 of 5 December. In order to access the instrument, they had to explicitly indicate their acceptance to participate in the research. In addition, the records were anonymised and the analyses were carried out in aggregate form.

Data analysis

SPSS 27 statistical software was used for data analysis. Descriptive and differential analyses of the data were performed. In the descriptive analysis, measures such as

percentages, averages and standard deviations were calculated, while in the differential analysis, statistical tests such as Student's t-test and ANOVA (with Scheffé's posterior contrasts) were used, with a confidence level of 99% in both cases (calculating the effect size with Cohen's d or η^2). A correlational study was also conducted between critical thinking and students' academic grades, calculating Pearson's coefficient with a 99% confidence level. It is important to mention that a total of 58 missing values were obtained, which were replaced by predicted values using the regression method.

Results

Descriptive analysis of the level of critical thinking among university students in Spain.

The results obtained show that, in general, undergraduate students in Spain have a high level of *critical thinking*, with an average of 145.23 and a standard deviation of 16.28 on a scale of 0 to 220 (Figure 1; Table 6). Specifically, it was observed that 0.06% of the student body presented low levels, 20.52% medium levels, 77.57% high levels and 1.82% very high levels.

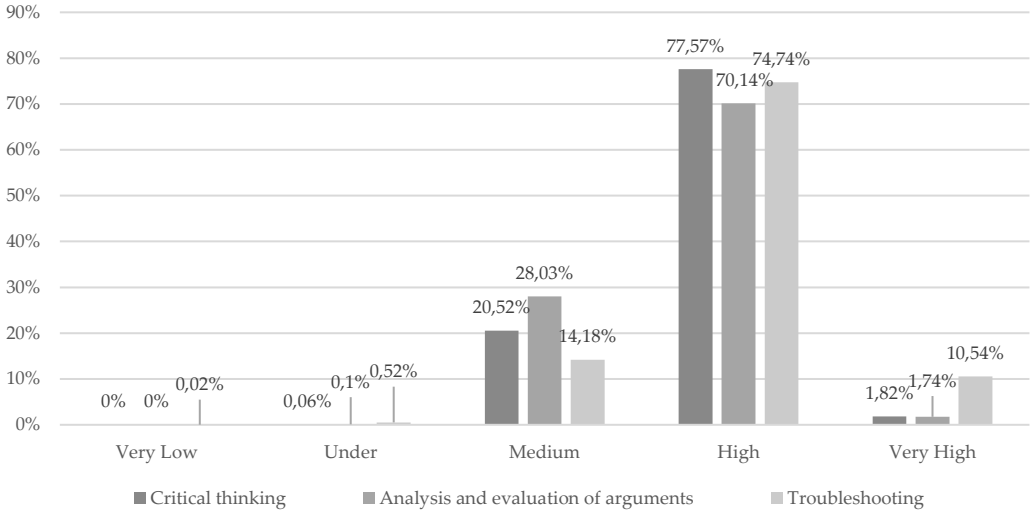

Figure 1. Distribution of the sample according to the level of critical thinking, analysis and evaluation of arguments and problem solving.

In relation to the *analysis and evaluation of arguments*, it should be noted that the level of this dimension is equally high, with a mean of 95.46 and a standard deviation of 11.66 on a scale of 0 to 148. In particular, 0.1% of our students were identified as having low

levels, 28.03% medium levels, 70.14% high levels and 1.74% very high levels in this dimension. Furthermore, within this dimension, two sub-dimensions were found: *argument analysis* and *argument evaluation*, both presenting high levels, with an average of 50.89 out of 80 and 44.56 out of a total of 68 points, respectively, and a high homogeneity in the answers, with a standard deviation of 6.78 and 6.61 respectively.

Table 6

Means and standard deviations (T.D.) of the sub-dimensions of Critical thinking

	Media	**D.T.**
Critical thinking [0-220].	145,23	16,28
Analysis and evaluation of arguments [0-148].	95,46	11,66
Argument analysis (0-80)	50,89	6,78
Identification and analysis of arguments (0-20)	13,30	3,13
Content identification and analysis (0-32)	21,24	3,57
Identification and analysis of relationships (0-28)	16,35	3,02
Evaluation of arguments (0-68)	44,56	6,61
Passive evaluation (0-48)	31,05	5,86
Active evaluation (0-20)	13,50	2,77
Troubleshooting (0-72)	49,76	6,63
[Phase 1] Problem identification and analysis (0-28)	20,93	3,06
[Phase 2] Identification of strategy and alternative (0-28)	18,99	2,85
[Phase 3] Strategy-led action (0-8)	4,96	2,066
[Phase 4] Final evaluation (0-8)	4,86	1,53

Regarding the *analysis of arguments*, it is observed that university students present high levels in the *identification and analysis of arguments* (average of 13.30 out of 20) and in the *identification and analysis of their content* (average of 21.24 out of 32), and medium-high levels in the *identification and analysis of their relations* (average of 16.35 out of 28).

In relation to *argument evaluation* skills, both in passive and active evaluation, high overall levels are observed, with an average of 31.05 out of 48 and 13.5 out of 20, respectively. Furthermore, a high homogeneity is found in the distribution of the subjects' scores, which is reflected in the values of the standard deviations obtained.

As for *Problem Solving*, the general level of ability is high, with an average of 49.76 and a standard deviation of 6.63 on a scale of 0 to 72. In detail, it is observed that 10.54% of the sample presents very high levels, 74.74% high levels, 14.18% medium levels, 0.52% low levels and 0.02% very low levels. Furthermore, it should be noted that university students show high skills in all phases of the *problem-solving* process, with an average of

20.93 on a 28-point scale in the *identification and analysis of the problem*, an average of 18.99 out of 28 in the *identification of the strategy and alternative*, an average of 4.96 out of 8 in *strategy-guided action* and an average of 4.86 out of 8 in the *final evaluation*. These results indicate that the students show a high level of competence in problem solving.

Differential analyses of the level of critical thinking among university students

The results of the differential studies according to the *gender* of the subjects (Table 7) indicate that women show significantly lower levels ($p<0.01$, with a small effect size, according to López-Martín and Ardura-Martínez, 2022) in *critical thinking* than men and non-binary people. These differences are maintained in *argument analysis and evaluation*, *argument analysis*, *content identification and analysis*, *argument evaluation*, *passive evaluation* and *final evaluation*.

Table 7

Differential analysis according to gender

	Man	Woman	Non-Binary	η^2
Critical thinking	147,08	143,89	149,84	0,01
Analysis and evaluation of arguments	97,40	94,08	99,61	0,02
Analysis of arguments	51,79	50,25	52,87	0,01
Identification and analysis of the cont.	21,69	20,92	22,15	0,01
Evaluation of arguments	45,60	43,82	46,74	0,02
Passive evaluation	32,01	30,39	32,74	0,02
Troubleshooting				
Identification of strategy and alternative				
Final evaluation	5,09	4,71	5,17	0,02

Note: 'H' refers to male, 'M' to female and 'MB' to non-binary person.

According to the *autonomous community*, as shown in Table 8, the results show that students in Andalusia obtain significantly lower scores in *analysis and evaluation of arguments* ($p<01$, with a small effect size, $\eta^2 = .02$) with respect to Catalonia and Asturias ($\chi_{Andalusia} = 93.94$; $\chi_{Catalonia} = 97.86$; $\chi_{Asturias} = 98.35$).

Table 8

Differential analysis according to autonomous community

Autonomous Community	Media
Asturias (Principality of)	98,35
Catalonia	97,86
Navarra (Comunidad Foral de)	97,49

Cantabria	97,08
Galicia	96,61
Madrid (Community of)	95,90
Basque Country	95,54
Murcia (Region of)	95,45
Valencian Community	94,80
Canary Islands	94,70
Castilla y León	94,47
Andalusia	93,94
Balears (Illes)	93,27
Aragon	92,65
Rioja (La)	91,66
Castilla La-Mancha	91,10
Extremadura	86,47

Note: η^2 =0.02

In relation to the *university* (Table 9), in general terms, the results show that the students with significantly higher levels of *critical thinking* (p<.01 with a mean effect size: η^2 =,04) are those belonging to the Universitat de Barcelona ($\bar{X}_{UB}$ =153.4), the Universidade da Coruña ($\bar{X}_{UDC}$ =152.3) and the Universidad Carlos III de Madrid ($\bar{X}_{UC3M}$ =150.88).

Table 9

Differential analyses of critical thinking as a function of the university

University	**Media**
University of Barcelona	153,4
University of A Coruña	152,3
Carlos III University of Madrid	150,889
Autonomous University of Madrid	150,64
University of Oviedo	148,84
University of Malaga	147,78
University of Seville	147,06
Open University of Catalonia	146,73
University of La Laguna	146,46
University of Santiago de Compostela	145,65
Euskal Herriko Unibertsitatea (University of the Basque Country)	145,56

Polytechnic University of Madrid	145,44
University of Vigo	145,35
University of Valencia	145,22
University of Valladolid	144,77
Polytechnic University of Valencia	144,69
University of Salamanca	144,58
University of León	143,8
Pablo de Olavide University	143,78
Rovira i Virgili University	143,37
Complutense University of Madrid	142,61
University of the Balearic Islands	142,12
University of Alicante	142
University of Zaragoza	141,97
University of Almeria	140
University of Granada	139,18

Note: η^2 =0.05

Depending on *the ownership of the school*, students from public universities show significantly higher levels (p<.01, with a very high effect size, according to Cohen, 1988) than those from private universities in *problem solving* and *identification of strategy and alternative* (Table 10).

In relation to the *university format*, the results show that students from on-site universities show significantly lower levels (p<0.01, with a small effect size) in *content identification and analysis* than students from distance learning universities (Table 10).

With respect to the *type of school*, students belonging to their own schools scored significantly better (p<.01, with very large effect sizes) both in *critical thinking* and in most of its dimensions and sub-dimensions compared to students belonging to affiliated schools (Table 10).

Table 10

Differential analyses according to ownership and format and typology of the centre

	Ownership			**Format**			**Typology**		
	Public	**Private**	**d**	**In person**	**Online**	**d**	**Own**	**Seconded**	**d**
Critical thinking							145,73	132,01	,85
Analysis and evaluation of arguments							95,82	85,95	,86
Analysis of arguments							51,08	46,01	,76
Identification and analysis of							13,37	11,46	,61

arguments									
Content identification and analysis				21,21	22,04	,23	21,31	19,29	,57
Identification and analysis of relationships							16,39	15,25	,38
Evaluation of arguments							44,74	39,94	,73
Passive evaluation							31,18	27,67	,60
Active evaluation							13,55	12,26	,47
Troubleshooting	49,83	48,64	,18						
Problem identification and analysis							21,00	19,32	,55
Identification of strategy and alternative	19,03	18,36	,23						

Depending on the branch of knowledge (Table 11), the results indicate that students in Social Sciences and Law obtain significantly lower scores in *critical thinking* ($p<.01$, with a medium-low effect size) than the rest of the students in the other branches of knowledge. Likewise, students in Health Sciences obtain significantly lower scores than students in Arts and Humanities and Science, and the latter obtain significantly higher scores than students in Engineering and Architecture. This trend is maintained, with slight changes, in the different dimensions and sub-dimensions of the construct.

Table 11

Differential analysis according to branch of knowledge

	AyH	CCSS	Science	C.Health	Ing and A.	η^2
Critical thinking	147,69	141,16	149,68	143,97	145,80	,04
Analysis and evaluation of arguments	97,68	92,67	98,52	93,73	96,21	,04
Analysis of arguments	97,68	92,67	98,52	93,73	96,21	,03
- Identification and analysis of arguments	13,97	12,75	13,73	13,18	13,35	,02
- Content identification and analysis	13,97	12,75	13,73	13,18	13,35	,01
Evaluation of arguments	45,57	43,10	46,43	43,43	44,92	,04
-Passive evaluation	31,71	30,00	32,47	30,05	31,44	,03
-Active evaluation	13,85	13,09	13,96	13,38	13,48	,02
Troubleshooting	50,00	48,48	51,16	50,24	49,58	,02
Problem identification and analysis	21,28	20,52	21,36	21,03	2,76	,01
Identification of the structure and alternative	19,15	18,41	19,56	19,41	18,76	,03
Final evaluation	4,77	4,67	5,08	4,85	4,98	,01

Note: 'A&H' refers to Arts and Humanities, 'CCSS' to Social Sciences and Legal Sciences, 'C. Health' refers to Health Sciences, and 'Eng. and A.' to Engineering and Architecture.

Depending on *the type of study*, it is found that double-degree students score significantly higher in *critical thinking* ($p<.01$, with a small effect size) than single-degree students (Table 12). These significantly higher scores are maintained with a small magnitude throughout most of the sub-dimensions related to the *analysis and evaluation of arguments*.

Table 12

Differential analysis according to study type

	Grade	Double Degree	d
Critical thinking	144,83	148,90	,25
Analysis and evaluation of arguments	95,13	98,45	,29
Analysis of arguments	50,70	52,69	,30
Identification and analysis of arguments	13,24	13,90	,21
Content identification and analysis	21,15	22,04	,25
Evaluation of arguments	44,43	45,75	,20
Passive evaluation	30,94	32,04	,20

Depending on the *year*, the average score in all dimensions and sub-dimensions tends to increase as the year increases (Table 13). That is to say, 6th grade students tend to obtain the highest scores, followed by 5th, 4th, 3rd and 2nd grade students, with 1st grade students obtaining the lowest scores. In particular, the ANOVA results indicate that there are statistically significant differences with a medium-low effect size ($p<.01$; $\eta^2 =.05$) in *critical thinking* between (a) students in 1st and 3rd, 4th, 5th and 6th grades, (b) students in 2nd and 3rd, 4th and 5th grades, and (c) students in 3rd and 5th grades (in favour of higher grades in all cases).

Table 13

Differential analysis according to course

	1º	2º	3º	4º	5º	6º	η2
Critical thinking	140,91	143,05	147,32	148,47	151,13	157,38	,05
Analysis and evaluation of arguments	92,33	94,07	96,97	97,69	100,02	102,42	,05
Analysis of arguments	49,68	50,22	51,74	51,66	53,27	54,22	,02
Identification and analysis of arguments	12,96	13,09	13,63	13,47	14,28	13,02	,01

Identification and analysis of content	20,66	21,06	21,41	21,64	22,08	23,43	,02
Identification and analysis of relationships	16,05	16,07	16,69	16,54	16,91	17,76	,01
Evaluation of arguments	42,64	43,84	45,23	46,03	46,74	48,19	,05
Passive evaluation	29,20	30,42	31,60	32,47	33,24	34,38	,06
Active Evaluation							-
Troubleshooting	48,57	48,97	50,34	50,78	51,11	54,95	,03
Identification of strategy and alternative	18,50	18,67	19,10	19,43	19,68	21,15	,02
Strategy-led action	4,69	4,85	5,15	5,15	5,21	6,10	,01
Final evaluation	4,60	4,77	4,95	5,08	5,01	5,92	,02

Correlational analyses between the dimensions and sub-dimensions of critical thinking and the average grade point average.

The results of the correlational analysis between critical thinking (at the global level and its dimensions) and *transcript score* indicate a significant positive, imperfect weak weak correlation (p<.01); DDancey and RReidy, 2007) in the case of *critical thinking* (overall), *argument analysis and evaluation*, *argument evaluation* and *passive evaluation*, with values between ,2 and ,22 (Table 14). These results suggest that students with higher grades tend to have higher levels of *critical thinking*, *argument analysis and evaluation*, *argument evaluation* and *passive evaluation*.

Table 14

Correlational analysis between Critical Thinking and score

	Academic transcript
Critical thinking (global)	,21
Analysis and evaluation of arguments	,2
Analysis of arguments	
Evaluation of arguments	,21
Passive evaluation	,22
Self-perception decision making	
Life Satisfaction	

Discussion and conclusions

The results obtained in this research have made it possible to achieve the general objective set, identifying the level of critical thinking of university students in Spain and highlighting significant differences according to various demographic variables. Thus, in general terms, undergraduate students in Spain have a high level of critical thinking,

which suggests a growing interest in fostering this type of thinking in recent decades. Likewise, the descriptive studies carried out allow the following conclusions to be drawn:

University students in Spain show a high level in analysing and evaluating arguments. Specifically, they show high skills in cognitively less demanding tasks, such as identifying and interpreting objections and challenges, and in identifying plausible alternative explanations. However, it shows the lowest levels in more cognitively existing skills that require explicit training, such as recognising the need to search for contrary evidence and identifying responsibility for the burden of proof.

Similarly, students show high levels in problem solving, especially in less cognitively demanding skills, such as identifying basic components of the problem. However, they show lower levels in more cognitively demanding skills, such as the identification of costs and benefits, the probability of success and the implications of alternatives in solving a problem.

For their part, the results of the differential analyses, according to the different variables considered in the study, yield the following conclusions:

As a function of gender, females were found to show lower levels of critical thinking compared to males and non-binary individuals, results consistent with those of other studies, such as Liu et al. (2019) and Vong and Kaewurai (2017).

Depending on the autonomous community, students from Andalusia were found to have lower levels of analysis and evaluation of arguments than those from Asturias and Catalonia. On the other hand, students at the Universitat de Barcelona, Universidad Carlos III de Madrid and Universidade da Coruña have the highest levels of critical thinking compared to other Spanish universities. However, it is important to note that the sample used for the study varies in size according to the autonomous community and university, which could affect the precision of the estimates and the detection of significant differences.

In addition, it was found that students at public universities have higher levels of problem solving and identification of strategies and alternatives than those at private universities, possibly due to differences in the faculty's conception of critical thinking (Bezanilla et al., 2018). In their study, these authors indicate that faculty at private universities tend to focus on the evaluative dimension of critical thinking, while those at public universities focus on decision-making, performance and commitment. However, caution is needed when interpreting these results, as further studies are needed to confirm these relationships.

In relation to university format, students at distance learning universities have higher levels of content identification and analysis compared to students at face-to-face universities. These findings are consistent with those of several previous studies, such as Leavy et al. (2022) and Setyawan (2019), which suggest that online students tend to perform better in specific areas, such as reading and quantitative reasoning. However, the underlying causes of these differences are not yet clear and more research is needed to

fully understand the differences between students in the two university formats.

With respect to the type of centre, students from the centres themselves have better critical thinking skills than those from affiliated centres. In addition, students in Social Sciences and Law have lower levels of critical thinking skills than those in other subject areas, but more research is needed to determine the impact of teaching and assessment practices on these disparities.

On the other hand, double degree students obtain higher scores in critical thinking than single degree students. As Fernández-Mellizo and Salvo (2019) indicate, double degrees attract students with higher admission scores who come from families with a better economic situation, so the economic factor could be an explanatory factor for this difference. Similarly, it is observed that scores in all dimensions and sub-dimensions increase as the course progresses. This finding is consistent with the results of the meta-analyses by Abrami et al. (2015) and Huber and Kuncel (2016), which point to the positive effect of university experience on students' levels of critical thinking. However, it is worth noting that the (small) magnitude of these differences is also in line with the results of previous meta-analyses. In this sense, and as indicated by Ennis (2018) and Roohr et al. (2019), although university experience seems to have a positive effect on the development of critical thinking, these gains are insufficient.

Finally, correlational analyses have shown a positive relationship between critical thinking and academic performance. In this regard, it should be noted that, unlike most of the variables considered in this study, the association between critical thinking and academic performance has been widely studied in the literature, with most studies reporting a positive relationship between the variables mentioned. Examples can be found in D'Alessio et al. (2019), Fong et al. (2017), Ghanizadeh (2017) and Kanwal and Butt (2021).

Based on the above, and despite the fact that the level of critical thinking among university students is high, the study presented here indicates that there is room for improvement in the development of critical skills in the Spanish university education system. Therefore, it seems necessary to design effective educational strategies and policies to foster the development of critical thinking among students. Furthermore, the findings of this research suggest that individual, university and autonomous community factors influence students' level of critical thinking, which highlights the importance of considering these factors in future research and educational programmes.

Further research is also needed to understand more precisely the differences among university students in relation to socio-demographic variables and critical thinking. Despite the limitations present in this study, such as the use of accidental non-probability sampling, the collection of data through the intermediary of faculty and school administrators, which may generate a bias towards schools and students interested in critical thinking, as well as the different sample size in the levels of the independent variables, the results suggest that there are important implications for faculty and

educational policies in terms of the design of programmes aimed at fostering critical thinking among university students. The pedagogical implications derived from the results on the relationship between socio-demographic variables and critical thinking indicate that faculty should take these variables into consideration when designing and implementing effective pedagogical strategies.

It is therefore recommended that, in addition to studying and implementing concrete measures based on these results to improve the development of critical thinking among students, further research should be carried out to test these results and to understand the underlying causes of the observed differences.

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