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ATTITUDES TOWARD ARTIFICIAL INTELLIGENCE AND GENDER DIFFERENCES AMONG SPANISH EMERGING ADULTS

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Abstract

New technologies are transforming the lifestyles, interactions and learning methods of young people. Among these new information and communication technologies, artificial intelligence (AI) platforms have recently experienced a significant boom. The importance of general attitudes towards AI has recently been examined to understand how and why it is used. The four-item AI Attitude Scale (AIAS) has recently been introduced to measure the general public's attitudes towards AI. This study aims to examine attitudes towards AI among university students in Spain and analyse the gender invariance of the AIAS-4. Methods: A cross-sectional design was employed by administering a self-report questionnaire to a sample of 407 university students (63.1% female; mean age = 21.93 years). The undergraduates were enrolled at ten higher education institutions in Andalusia, Spain, and completed an online questionnaire in spring 2025. Results: The study provided psychometric validation of the AIAS-4 in a sample of Spanish undergraduates, providing descriptive information about attitudes towards AI that could inform the design of programs promoting positive use and discouraging risky and deviant behaviours. The invariance analyses showed gender invariance at the configural and metric levels, with no differences in the resulting factor nor in the factor loadings of the indicators. Differences were found at a scalar and strict levels, resulting in differences in both intercepts and residuals. Thus, measurement bias may explain that women reported most sceptical attitudes towards AI and especially concerning that AI will improve our lives. Discussion: Gender-sensitive instruments should be designed in order to prevent measurement bias. This research emphasised the need for effective interventions to foster positive attitudes towards AI and encourage critical and ethical use among male and female higher education students.

Key words: AI, attitudes, measurement, gender, youth, university.

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СТАВОВИ ПРЕМА ВЕШТАЧКОЈ ИНТЕЛИГЕНЦИЈИ И РОДНЕ РАЗЛИКЕ МЕЂУ ШПАНСКИМ МЛАДИМ ОДРАСЛИМ ОСОБАМА

Апстракт

Нове технологије трансформишу животне стилове, интеракције и методе учења младих људи. Међу овим новим информационо-комуникационим технологијама, платформе вештачке интелигенције (ВИ) недавно су доживеле значајан бум. Важност општих ставова према ВИ у скорије време је испитана како би се разумело како и зашто се она користи. Четворостепена скала ставова према ВИ (AIAS) недавно је уведена да би се мерили ставови опште јавности према ВИ. Ова студија има за циљ да испита ставове према ВИ међу студентима у Шпанији и да анализира постојање родне раулике у ставовима према скали AIAS-4. Методе: Коришћен је cross-sectional дизајн применом самопријављивачког упитника на узору од 407 студената (63,1% жена; просечна старост = 21,93 године). Студенти основних студија били су уписани на десет високошколских установа у Андалузији, Шпанија, и попунили су онлајн упитник у пролеће 2025. године. Резултати: Истраживање је обезбедило психометричку валидацију AIAS-4 у узорку шпанских студената основних студија, пружајући описне информације о ставовима према вештачкој интелигенцији које могу информисати дизајн програма за промоцију позитивне употребе и одвраћање од ризичних и девијантних понашања. Анализе инваријантности показале су родно инваријантну структуру на конфигурационом и метричком нивоу, без разлика у резултујућем фактору или факторским оптерећењима индикатора. Уочене су разлике на скаларном и строгом нивоу, што је резултирало разликама и у интерцептима и у резидуалима. Дакле, пристрасност у мерењу може објаснити зашто су жене пријавиле највише скептичних ставова према ВИ, а посебно забринутости да ће ВИ побољшати наше животе. Дискусија: Треба дизајнирати родно осетљиве инструменте како би се спречила пристрасност у мерењу. Ово истраживање је нагласило потребу за ефикасним интервенцијама за неговање позитивних ставова према ВИ и подстицање критичке и етичке употребе међу студентима и студенткињама високог образовања.

Кључне речи: вештачка интелигенција, ставови, мерење, пол, млади, универзитет.

INTRODUCTION

New technologies are shaping the lifestyles, interactions and learning methods of young people. Among these new information and communication technologies, artificial intelligence (AI) platforms have recently experienced a significant boom. AI is defined as the application of computer systems that can perform tasks or produce results that usually require human intelligence, particularly through machine learning techniques applied to large amounts of data (Naiseh et al., 2025). From a functional perspective, AI is a technological system that can immediately provide any type of information and solve problems related to any field of knowledge or area of life (Lim & Shim, 2022). AI is also understood as an interactive conversational agent that can directly affect decision-making and interpersonal communication. While it facilitates the completion of tasks and pro-

vides solutions to difficulties without the need for human capacity, it also provides interactive environments that could have repercussions for users' psychological well-being. AI is currently establishing itself as a cross-cutting technology capable of modifying various domains, such as health, education, and social interaction. It directly impacts behaviour, cognition, and mental health (Salazar et al., 2024; Monteith et al., 2024).

As with any technological advance, there are conflicting opinions, with some boasting about the advantages it brings to human progress and others warning of the dangers that its misuse may entail (Müller, 2016; Zhang et al., 2022). One of the most frequently discussed dangers is the fear of losing job opportunities due to the automation of tasks and processes. This potential replacement has caused particular alarm in the healthcare and education sectors, where concerns have been raised about the protection of personal data, biased decision-making and a lack of regulation and transparency. Similarly, inappropriate AI use can result in risky behaviour and criminal conduct, such as creating false content, distorting reality, or committing identity theft. Inappropriate use can be detrimental academically, as it can involve generating artificial texts and passing them off as original work. It can also have negative relational consequences, as inappropriate content can be used as a tool for cyberbullying (Hoanca & Mock, 2020). Conversely, the responsible use of AI can enhance learning and content creation, making people's lives and work easier (Scherer, 2015). Given these circumstances, it is imperative to consider the possible psychological and psychosocial consequences when specifying the configuration and regulation of this technology (Chan et al., 2024; Sabour et al., 2025).

Attitudes towards AI

The strong impact that this algorithm-based technological system appears to be having on the world's population creates an urgent need for studies to develop digital education models aimed at training people in the proper use of AI. This will help minimise any potential adverse psychological effects. This issue requires urgent attention from experts conducting rigorous scientific research to address this complex issue, which combines multidisciplinary fields with technological innovation. Training young people in the proper use of AI, both inside and outside the academic field, can promote ethical use and discourage behaviour that endangers their own or others' well-being. Training in AI based on critical thinking and ethical regulation can transform this tool into a technological instrument that opens new avenues of development for young people, as previous technologies have done (Kamila & Jasrotia, 2025).

Recently, the importance of general attitudes toward AI has been examined to explain its use and type of use (De Freitas et al., 2023). In the field of social sciences, the study of attitudes has accumulated a large amount of research to understand the background of various behaviours. In

this vein, the rapid advancement of AI in recent years has generated a growing demand for instruments that can assess public attitudes toward AI technology (Stein et al., 2024). Understanding the role of attitudes can also contribute to the creation of educational initiatives and public awareness campaigns that address concerns and misunderstandings about artificial intelligence, highlighting both its capacity to generate benefits and the risks that must be understood in a reasoned manner (Sindermann et al., 2021). By promoting a deeper understanding of social perceptions and expectations surrounding AI, researchers and policymakers can work together to ensure that its development and application are carried out in an ethical and responsible manner. This cooperation will enable us to maximise the benefits of AI and reduce its potential risks, promoting a more balanced integration of these technologies into everyday life and society.

To measure attitudes toward AI, several self-report measures have been developed and have begun to accumulate empirical evidence. While some measures have been designed to measure attitudes toward technology, such as the Technology Acceptance construct (Davis, 1989), and toward media use, such as the Media and Technology Usage and Attitudes Scale (MTUAS, see Rosen et al., 2013), only recently have specific measures applied to AI emerged. The first scales to appear were the General Attitudes toward Artificial Intelligence Scale (GAISS; a 20-item scale distributed across two factors of negative and positive attitudes toward AI; Schepman & Rodway, 2020, 2023) and the Threat of Artificial Intelligence Scale (TAI; which specifically measures fear of AI technology; Kieslich et al., 2021). More recently, the four-item AI Attitude Scale (AIAS) has been introduced to measure public attitudes toward AI. This scale is based on the Unified Theory of Technology Acceptance and Use (Venkatesh et al., 2003), which is a theoretical model that explains users' intentions to adopt new information systems and their usage behaviour (Marikyan & Papagiannidis, 2025). This model integrates four key constructs: performance expectancy (the degree to which the user believes the technology will improve their performance), effort expectancy (the degree of ease associated with using the system), social influence (the degree to which others influence the decision to use the system), and enabling conditions (the belief that adequate technical and organisational infrastructure exists). Furthermore, this scale analyses various aspects of AI's potential influence on people's lives, work, and human experience in general, while also addressing the likelihood of future AI adoption (Grassini, 2023). The AIAS scale is designed to capture attitudes toward AI by focusing on the perceived usefulness and potential impact of technology on society and humanity, including perceived benefits, potential risks, and intentions to use AI technologies.

The Present Study on Attitudes towards AI and Gender Differences

The AIAS scale was originally validated by Grassini (2023) in adults from the United Kingdom and the United States, and has recently been validated in other languages, such as Norway (Mogelvang & Grassini, 2025) and Peru (Morales-Garcia et al., 2024), demonstrating good psychometric properties. This study aims to examine attitudes toward AI among university students in Spain. Furthermore, it seeks to examine the psychometric properties of this measure, aiming to provide a valid and reliable instrument for use in programs promoting the appropriate use of AI and preventing deviant behaviour in its use.

Finally, this work also aims to analyse gender differences in the scale's indicators, as well as the invariance of the measure. Gender differences have been observed in attitudes towards AI in various professional settings, such as teachers (Zhang et al., 2023), medical and pharmacy students (Guven et al., 2024), dermatologists (Shen et al., 2020) and nursing staff (Morales-García et al., 2024). When designing effective interventions, a gender perspective cannot be ignored, and this is particularly important when it comes to preventing externalising, criminal, or deviant behaviours, which are more prevalent among young men. In Higher Education, Ofosu-Ampong (2023) showed that females view AI-based learning tools as less favourable than males in education. This author argued the need to improve women's perception of the utility of AI-based tools, as well as reducing the risk of misuse. Russo et al. (2025) found that women reported higher AI anxiety, lower positive attitudes toward AI, lower use of AI, and lower perceived knowledge of AI. Concerning gender differences in AI use, Mogelvang et al. (2024) concluded that men were found to exhibit a comparatively stronger interest in generative AI chatbots as functional tools and in their potential relevance for future professional trajectories. Women, in contrast, tended to employ generative AI chatbots more frequently for text-oriented tasks and articulated more pronounced concerns regarding the preservation of critical and independent thinking. Additionally, women expressed a greater need for guidance on how to discern appropriate contexts for using generative AI chatbots and how to evaluate their trustworthiness. Similarly, evidence has shown that AI tools can be used in ways that disproportionately harm women, girls, and minority communities (Petershek, 2025). Among these potential risks are deepfakes, which involve using AI to recreate a person's face or voice without their consent, making them appear to be doing or saying something they are not, with the aim of generating cyberbullying. This study aims to examine the gender invariance of the AIAS-4 scale among young Spanish university students.

METHODS

Data Collection Procedure and Instrument

A cross-sectional design was employed during the spring of 2025. Undergraduate participants completed an online, self-administered questionnaire. Regarding the recruitment procedure, each participating university implemented a random selection strategy to determine both the academic year and the degree programs to be included. Faculty members from the selected programs were subsequently contacted to disseminate the survey link to their students. The completion time for the questionnaire was approximately 30 minutes. All participants provided written informed consent and received no compensation for their involvement. Ethical approval for the study was granted by the Institutional Ethics Committee of XX and all procedures adhered to the principles outlined in the Declaration of Helsinki.

The Attitude towards Artificial Intelligence Scale (AIAS; Grassini, 2023) was used to evaluate individuals' general dispositions toward artificial intelligence. The instrument consists of four items and has been previously validated in samples from the United States and the United Kingdom. It captures respondents' perceptions regarding the potential impact of AI on their personal lives, professional trajectories, and society at large. A global score reflecting attitudes toward AI—integrating perceived usefulness and anticipated societal implications—was computed by summing item responses. The scale employs a 10-point Likert response format (1 = not at all; 10 = completely agree), with higher scores indicating more favourable attitudes toward AI. The Spanish version of the AIAS was developed following a rigorous cultural adaptation procedure (Morales-García et al., 2024).

Participants

The final sample consisted of 407 university students (63.1% women; *M* age = 21.93 years) enrolled across ten higher education institutions in Andalusia, Spain. The proportion of participants from each university was as follows: University of Almería (2.5%), University of Cádiz (3.5%), University of Córdoba (8.0%), University of Granada (10.7%), University of Huelva (15.7%), University of Jaén (10.7%), University of Málaga (13.2%), University of Sevilla (27.9%), University Pablo de Olavide (5.7%), and Loyola University (2.2%). Regarding academic progression, 14.9% were first- or second-year students, 40.8% were in their third year, and 44.3% were in their fourth to sixth year or enrolled in a master's program.

In terms of disciplinary fields, nearly half of the participants were studying Social Sciences or Law (45.8%), while the rest were distributed across Sciences and Engineering (24.4%), Arts and Humanities (17.7%), and Health Sciences (12.2%). Concerning personal characteristics, 52.6% reported not being in a romantic relationship, and the vast majority (94.9%)

identified as Spanish. With respect to living arrangements, 42.9% resided with their parents and 32.3% lived with roommates. Finally, 37.3% lived in large urban areas (over 300,000 inhabitants), whereas 35.1% lived in medium-sized cities (50,001–300,000 inhabitants).

Data Analysis Design

First, descriptive statistics were examined (i.e., mean and standard deviation) in the scale of attitudes towards AI. Second, bivariate zero-order Pearson correlations were conducted between the items. Third, internal consistency reliability was analysed by calculating alpha and McDonald indexes. Fourth, factorial validity was examined. A principal component analysis (Promax rotation) was carried out, presenting Kaiser-Meyer-Olkin (KMO) test and Bartlett's test of sphericity. Then, a confirmatory factor analysis was conducted showing overall model fit indexes, i.e., $\chi 2$, Comparative Fit Index (CFI), Root mean square error of approximation (RMSEA) and Bentler-Bonett Non-normed Fit Index (NNFI). Fourth, T-tests were performed to examine gender differences in the items and overall score in attitudes towards AI. Cohen's d was calculated for effect size. Fifth, measurement invariance by gender was conducted to test configural invariance, metric invariance, scalar invariance and strict invariance. A significance level of $p < .05$ was used for all the analyses. Statistical package JASP 0.18.3 was used for all the analyses.

RESULTS

Descriptive Statistics, Bivariate Correlations among the Items and Internal Consistency

Table 1 shows the descriptive statistics and the bivariate correlations among the items of the AAIS. Since the scores can range from 1 to 10, mean scores indicated moderate positive attitudes towards AI, with the

Table 1. Descriptive statistics and Pearson bivariate correlations

	English version	Spanish version	M	SD	1	2	3	4
1	I believe that AI will improve my life	Creo que la IA mejorará mi vida	5.76	2.68	1			
2	I believe that AI will improve my work	Creo que la IA mejorará mi trabajo	6.04	2.83	0.80***	1		
3	I think I will use AI technology in the future	Pienso que usaré tecnología de IA en el futuro	7.24	2.76	0.74***	0.79***	1	
4	I think AI technology is positive for humanity	Pienso que la tecnología IA es positiva para la humanidad	6.02	2.70	0.75***	0.76***	0.69***	1

highest score in the item reporting future use of AI. The four items showed high positive correlations, with the highest correlations between items 1 and 2, concerning the beliefs about an improvement in life and work due to AI use. With regards to internal consistency, the scale showed excellent reliability, $\alpha = 0.93$, $\Omega = 0.02$.

Factorial Validity

Table 2 describes the results of a principal component analysis to explore factorial validity of the scale. Both KMO and Bartlett's tests indicated that the dataset was suitable for performing a factor analysis. The results showed one unique factor, with 82% of variance explained. All the items showed very high saturations, around 0.90.

Table 2. Principal component analysis

	Rotated solution		Saturations	Uniqueness
	Sum Sq. Loadings	Proportion var.		
Component 1	3.27	0.82		
Item 1			0.93	0.14
Item 2			0.91	0.17
Item 3			0.89	0.21
Item 4			0.88	0.22

KMO = 0.854; Bartlett's test = 6441.61, p <0.001; $\chi 2 = 305.29$, p <.001

Table 3 showed the results of the confirmatory factor analysis and Figure 1 represents the structure of the scale reporting the standardised coefficients. The confirmatory factor analysis testing the integration of the four items into a unique factor found good overall data fit. All the indicators showing very high and positive saturations in the factor, with standardised coefficients over 0.80.

Table 3. Confirmatory factor analysis

	$\chi 2$, p	CFI	NNFI	RMSEA	Est	SE	Z	p	LLCI	ULCI
Factor mode	5.17, 0.076	0.997	0.002	0.063						
Item 1					1.61	0.16	10.19	<0.001	1.30	1.92
Item 2					1.26	0.15	8.20	<0.001	0.96	1.56
Item 3					2.17	0.19	11.47	<0.001	1.80	2.54
Item 4					1.25	0.19	11.67	<0.001	1.87	2.63

Note. Est: Estimate; SE: Standard error, LLCI: Lower-Level Confidence Interval: ULCI: Upper-Level Confidence Interval.

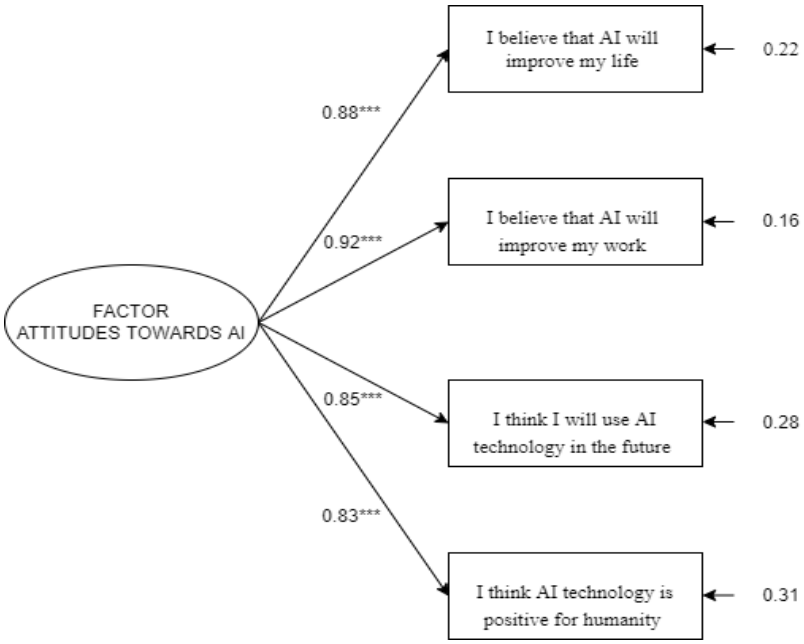

Figure 1. Confirmatory factor analysis

Gender Differences Analysis in the Items and the Overall Scale

Table 4 reports the results of the t-tests to examine gender differences in the items and overall score in the AAIS. Gender differences were observed in all the items, so that male reported more positive attitudes towards AI than females, with small to medium effect sizes. The greatest difference was found in item 1 about the belief that AI will improve own life. In the same line, males showed a higher overall score in the scale than women.

Table 4. T-tests to examine gender differences in separate items and overall scale

	Female M(SD)	Male M(SD)	t-test	p	Cohen's d
1 I believe that AI will improve my life	5.34(2.62)	6.57(2.58)	-4.54	<0.001	-0.47
2 I believe that AI will improve my work	5.78(2.77)	6.57(2.83)	-2.72	0.007	-0.28
3 I think I will use AI technology in the future	7.06(2.75)	7.65(2.68)	-2.07	0.039	-0.22
4 I think AI technology is positive for humanity	5.67(2.66)	6.70(2.62)	-3.76	<0.001	-0.39
Overall score	5.97(2.41)	6.87(2.45)	-3.59	<0.001	-0.37

Measurement Invariance Analysis

Table 5 shows the results of the measurement invariance analysis to test configural (same structure), metric (equal factor loadings), scalar (equal intercepts, so that group differences in mean scores are due to differences in the underlying latent construct rather than item bias), and strict (equal residuals) invariances by gender, applying Maximum Likelihood (ML) Estimation. No significant differences by gender were observed neither in the structure nor in the factor loadings, so that configural and metric invariance were supported. However, scalar and strict invariances were not supported. Differences were observed in the intercepts (expected mean value when the underlying latent factor is zero) and the residuals (the differences between the actual observed values and the values predicted by a regression line in the CFA), as indicated the significance of scalar and strict invariance tests. If scalar invariance would enable meaningful comparisons of latent mean scores, ensuring that observed group differences reflect true differences in the construct, scalar variance pointed out that the differences across the groups of males and females were due to measurement bias. Thus, in the present study for the same level of the latent variable of AI attitude, the groups of men and women obtained different scores on the test items. Table 6 shows the estimates of the intercepts in the four items sepa-

Table 5. Measurement invariance by gender

	$\chi 2$	df	p
Baseline model	1246.44	12	
Configural	5.492	4	0.240
Metric	8.89	7	0.261
Scalar	25.75	10	0.004
Strict	51.32	14	<.001

Note. ML estimator; df= degrees of freedom; p = significance

Table 6. Gender differences in the estimates of intercepts in the scalar measurement invariance analysis

Group	Items	Est	SE	Z	p	LLCI	ULCI
Male	Item 1	2.41	0.16	14.83	<0.001	2.01	2.70
	Item 2	2.63	0.18	14.69	<0.001	1.71	2.43
	Item 3	2.35	0.18	13.36	<0.001	1.94	2.47
	Item 4	2.07	0.18	11.33	<0.001	2.24	2.77
Female	Item 1	2.21	0.14	16.35	<0.001	1.97	2.53
	Item 2	2.50	0.14	18.36	<0.001	1.97	2.51
	Item 3	2.25	0.14	15.64	<0.001	2.01	2.70
	Item 4	2.24	0.14	16.30	<0.001	1.71	2.43
Male	Factor 1	1.00	0.00			1.00	1.00
Female		0.92	0.15	6.36	<0.001	0.64	1.21

Note. Est: Estimate; SE: Standard error, LLCI: Lower-level Confidence Interval: ULCI: Upper-Level Confidence Interval.

rately in the sample of males and females, with higher scores in the items 1-3 in males, and higher score in the item 4 in females. Consequently, these results of this scalar invariance test prevented us from drawing accurate conclusions about the t-tests for gender differences analysed above. Furthermore, Table 7 describes the results of the strict measurement invariance analysis. Differences in the residuals were found in all the items, with higher scores in females in the items 1-3, and higher score in the item 4 in males.

Table 7. Gender differences in the residual variances in the strict measurement invariance analysis

Group	Indicator	Est	SE	Z	p	LLCI	ULCI
Male	Item 1	0.81	0.17	4.82	< .001	0.48	1.14
	Item 2	1.05	0.20	5.14	< .001	0.65	1.45
	Item 3	1.60	0.23	6.83	< .001	1.14	2.06
	Item 4	2.53	0.33	7.70	< .001	1.88	3.17
Female	Item 1	1.97	0.23	8.71	< .001	1.53	2.41
	Item 2	1.35	0.21	6.50	< .001	0.94	1.76
	Item 3	2.46	0.27	9.24	< .001	1.94	2.99
	Item 4	2.05	0.24	8.71	< .001	1.59	2.51

Note. Est: Estimate; SE: Standard error, LLCI: Lower-level Confidence Interval: ULCI: Upper-Level Confidence Interval.

DISCUSSION

This research aimed to examine general attitudes toward AI in a sample of young university students in Spain, analysing gender invariance. The results showed that the studied sample held moderately positive attitudes toward AI. The most positive attitude concerned the potential future use of this technology, while the lowest was found regarding the belief that AI will improve their own lives. These results may indicate that they expect future use, but currently they have some doubts about the use and utility, consistently with the controversy already pointed out by previous researchers (Sabour et al., 2025; Zhang et al., 2022). Concerning the validity of the scale, the items were highly correlated, achieving excellent reliability through internal consistency. Finally, the scale showed adequate factor validity, with all four indicators exhibiting high loadings on a single factor. These results were in line with the original work by Grassini (2023) and the Spanish adaptation in Peru by Morales-García et al. (2024). As a contribution of the present work, we provided updated data of attitudes towards AI in an undergraduate sample in Spain, and a psychometric analysis what extend the validity of the AIAS-4 instrument in other country and sample type.

Regarding the study of gender differences, this article observed noteworthy results. The invariance analysis showed that the AIAS-4 scale exhibits gender invariance at the configural and metric levels, with no dif-

ferences in the resulting factors (one) or in the factor loadings of the indicators. However, no invariance was observed at scalar and strict levels, resulting in differences in both intercepts and residuals. The results indicated higher intercept scores for items 1-3 among men, and for item 4 among women. Residual scores showed gender differences contrary to those observed in the intercepts. Thus, although our preliminary t-tests reported that young men presented more positive attitudes toward AI than young women, with a difference even greater with respect to the belief that AI will improve their lives, invariance analyses showed that these differences were due to measurement bias rather than true differences in the construct. Thus, for the same level of the latent variable of AI attitude in men and women, they provided different scores on the test items. Self-report measure may produce inaccurate results for men or women perhaps due to ingrained stereotypes that may leads to gender-distorted data. These gender differences were consistent with previous literature with self-report measures which examined various professional settings and used different scales, such as teachers (Zhang et al., 2023), medical and pharmacy students (Guven et al., 2024), dermatologists (Shen et al., 2020) and nursing staff (Morales-García et al., 2024). Recent studies have tried to explain why men generally reported more positive attitudes toward AI compared to women (Pew Research Center, 2025; Renz et al., 2024). This gender gap is often characterised by higher levels of optimism, greater excitement, and lower levels of anxiety regarding AI's impact on work, society, and daily life among men samples. A recent study has demonstrated a higher willingness to use advanced AI in men for self-improvement and workplace productivity. On the contrary, women tend to use generative AI chatbots less often than men, reporting fewer use cases and approaching them more critically, expressing greater worries about losing independent thinking, and considering weaker connection between using these tools and improving their employability (Møgelvang et al., 2024). Consequently, women had more sceptic attitudes towards AI, what may relate to an increased anxiety towards AI, as documented Russo et al. (2025), Women's higher levels of AI anxiety may arise partly from gender stereotypes that discourage engagement with STEM fields and technological skills. Moreover, women tend to view AI systems, including robots, as less socially desirable than men, associating them with declines in face-to-face communication. Importantly, these differences may be also explained because AI tools can be used in ways that disproportionately harm women and girls, such as deepfakes, normalisation of misogyny and AI-powered harassment (Petershek, 2025). These reasons may bias the responses in the items in a self-report instrument.

The present work had the contribution of conducting a measurement invariance analysis of the AIAS-4, to conclude where the differences were by gender. The results showed that the factor structure was the same in men and women, but there were differences in the intercepts and residuals. Pro-

gram design to work with attitudes towards AI may follow a gender perspective, to examine the different uses, expectations and worries in men and women. A measurement bias explained that women were found to report more scepticism regarding the potential of AI to improve human life. Consequently, gender-sensitive measurement instruments should be designed to prevent bias in the analysis of gender differences, as well as integrating the use of multiple informants and performance measures regarding AI. Despite the contributions of this study, some limitations must be acknowledged, which present interesting avenues for future research. The use of a non-representative student sample limits the potential generalisability of the results. Furthermore, studying a sample of young university students does not allow for the generalisation of the results to the entire youth population. In addition, our sample comprised a higher proportion of women than men. Therefore, future research should follow sampling procedures that include young people from different educational and professional backgrounds, as well as random selections that allow for generalisation and allow for a gender-balanced composition. Furthermore, the use of a self-report tool for attitudes may incur the risk of social desirability bias. Thus, the current rise of AI may generate positive bias among students. The measure needs to be complemented with other instruments that examine frequency of use, the AI tool used, ethical use, perceived risk, and self-regulation in its use. Likewise, future research should control other sociodemographic variables, such as family socioeconomic status, in addition to gender. With a view to exploring potential ethical dilemmas and how their type of use is determined, as well as the training received regarding AI technology, it is recommended to complement quantitative research with mixed designs that employ interviews or focus groups.

Practical Implications

This work may have implications for practice and policy design. University students are adopting AI at an accelerating and seemingly unstoppable rate. However, this rapid expansion has sparked growing concerns about the ethical, technical and critical competencies required to understand its implications fully, not only for the students themselves, but also for the wider community (Cordero-Monzón, 2025; Francis et al., 2024; Yusuf et al., 2024). Slimi and Villarejo (2023) argue that academic institutions play a critical role in examining the ethical, social and policy dimensions of AI to support its responsible development and implementation. Contemporary AI ethics frameworks emphasise the importance of: a) enhancing the transparency and explainability of these systems may help lessen the negative impacts associated with technological displacement; b) safeguarding fair use and protecting individuals, particularly those belonging to vulnerable groups, is essential; and c) mitigating gender bias is imperative throughout algorithm design, training data selection, and AI-driven decision-making processes.

Research such as that conducted by Vega-Reinel et al. (2025) suggests that, while AI has the potential to enhance academic productivity, it can also exacerbate feelings of vulnerability among students and faculty members who often find it challenging to comprehend and effectively manage its application. Both groups are alarmed by this situation, particularly regarding risks to personal data and the opacity of AI systems (Reina-Marín, 2025; Sah et al., 2025). According to Wickramasinghe et al. (2025), Xia et al. (2024) and other scholars, the responsible and secure integration of AI in higher education requires the safeguarding of ethical principles such as data protection, transparency and accountability. In this regard, Lund et al. (2025) argue that students' ethical convictions impact their AI-related behaviour more than institutional regulations do. Therefore, mitigating the negative consequences of AI demands clear regulatory frameworks and the development of personal ethics and critical thinking — key competencies that substantially reduce potential risks for university students (Francis et al., 2024; Cedeño-López et al., 2024). Fiok et al. (2022) indicated that in recognition of the challenges posed by introducing AI, greater attention is needed to the necessity of understanding the factors that drive AI decisions. They argued that interventions need to provide explainable AI for education and training. Explainable AI pursues several objectives: a) transparency allows us to understand how a system arrives at a specific decision; b) causality analyses the extent to which the variables in the model are related to each other; c) privacy determines whether external agents can access the original data used in training; d) fairness serves to assess the level of absence of bias or ethical discrimination within the model; e) trust reflects how secure the system's performance is when faced with different problems; f) usability describes the system's ability to interact with the user safely and effectively, and finally, g) reliability measures the consistency of the model's results when faced with similar conditions. The intervention to promote an explainable AI may be gender-sensitive, to reach these characteristics equally in both women and men and to prevent measurement bias.

Alam (2023) have designed a curriculum for ethical and responsible AI in the form of a university course. The course is structured to cultivate a deep and critical understanding of the technical foundations and ethical considerations involved in creating and deploying artificial intelligence systems. Its interdisciplinary orientation integrates key insights from computer science, philosophy, and legal studies. Instruction is organised into four principal modules (safety, fairness, privacy, and ethics) each addressing a central dimension of responsible AI development. A diverse set of teaching methods supports student engagement, including interactive lectures, analytical case studies, collaborative discussions, and practical project-based activities. The case studies draw on real-world AI implementations and their societal and ethical ramifications, enabling students to ex-

amine the multifaceted challenges and opportunities that accompany contemporary AI technologies. By the end of the course, students should be able to articulate and analyse the technical and ethical issues surrounding AI, design systems that adhere to principles of safety, fairness, privacy, and ethical integrity, and critically assess the broader societal impacts of AI-driven innovation. Future curriculum design may also address the specific concerns and motivations by gender to create more effective interventions.

CONCLUSION

This study provided psychometric validation of the AIAS-4 in a sample of Spanish undergraduates, providing descriptive information about attitudes towards AI to inform the design of programs that promote positive use and mitigate risks and deviant behaviours. The invariance analyses showed gender invariance at the configural and metric levels, with no differences in the resulting unique factor nor in the factor loadings of the indicators. Differences were found at a scalar and strict levels, resulting in differences in both intercepts and residuals. Thus, measurement bias may explain that women reported most sceptical attitudes towards AI and especially concerning that AI will improve our lives. Gender-sensitive instruments should be designed in order to prevent measurement bias. The study emphasised the importance of fostering positive attitudes towards AI among both male and female higher education students through effective interventions that encourage critical and ethical use.

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СТАВОВИ ПРЕМА ВЕШТАЧКОЈ ИНТЕЛИГЕНЦИЈИ И РОДНЕ РАЗЛИКЕ МЕЂУ ШПАНСКИМ МЛАДИМ ОДРАСЛИМ ОСОБАМА

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Резиме

Рад се бави испитивањем ставова студената према вештачкој интелигенцији, са посебним освртом на проверу психометријских карактеристика скале AIAS-4 и анализу родне мерне инваријантности. Полазећи од све веће примене система заснованих на вештачкој интелигенцији у образовању и свакодневном животу, истра-

живање има за циљ да утврди како студенти перципирају потенцијалне користи, ризике и будућу употребу ове технологије, као и да ли инструмент који мери ставове функционише једнако код испитаника различитог пола. Посебна пажња усмерена је на питање да ли уочене разлике у ставовима између мушкараца и жена представљају стварне разлике или су последица мерне пристрасности инструмента.

Истраживање је спроведено на узорку од 407 студената са десет високошколских установа у Андалузији. Подаци су прикупљени применом онлајн упитника који је обухватао социодемографска питања и скалу AIAS-4 за мерење ставова према вештачкој интелигенцији. У анализи података коришћене су дескриптивне статистичке методе, процена поузданости инструмента, конфирматорна факторска анализа, као и тестирање мерне инваријантности по полу кроз више нивоа (конфигурациона, метричка, скаларна и строга инваријантност). Поред тога, анализиране су и разлике у просечним вредностима ставова између мушкараца и жена.

Резултати истраживања показали су да студенти у целини имају умерено позитивне ставове према вештачкој интелигенцији. Највише вредности забележене су код тврдњи које се односе на будућу примену вештачке интелигенције и њен потенцијал да унапреди различите области живота, док су резервисанији ставови уочени у погледу непосредног утицаја ове технологије на побољшање квалитета живота. Скала AIAS-4 показала је задовољавајуће психометријске карактеристике, уз високу унутрашњу конзистентност и једнофакторску структуру, што указује да инструмент адекватно мери општи став према вештачкој интелигенцији.

Анализа родне мерне инваријантности указала је на постојање конфигурационе и метричке инваријантности, што значи да мушкарци и жене на сличан начин разумеју структуру инструмента и да су односи између ставки и латентне варијабле упоредиви. Међутим, скаларна и строга инваријантност нису потврђене, што указује на могућу мерну пристрасност. Ови налази сугеришу да уочене разлике у просечним вредностима ставова између мушкараца и жена треба тумачити са опрезом, јер могу бити последица различитог функционисања инструмента, а не стварних разлика у ставовима према вештачкој интелигенцији.

На основу добијених резултата закључује се да студенти генерално показују позитивну оријентацију ка употреби вештачке интелигенције, али да је неопходно даље унапређивати мерење ставова, посебно у погледу родне осетљивости инструмената. Рад указује на значај развоја поузданих и валидних инструмената који ће омогућити прецизније праћење ставова према новим технологијама, као и на потребу увођења образовних програма који ће подстицати критичко, етичко и одговорно коришћење вештачке интелигенције у академском и ширем друштвеном контексту.