DOI: 10.28934/jwee26.12.pp195-217
JEL: L26, J16, I23

ORIGINAL SCIENTIFIC PAPER

Objective vs. Perceived Digital Entrepreneurial Competencies of Female Students in Serbia

Nevena Veselinović[1]
Ivana Domazet[2]
Milena Lazić[3]
Institute of Economic Sciences, Digital Economics Department, Belgrade, Serbia

A B S T R A C T

This study examines the relationship between perceived and objectively demonstrated digital entrepreneurial competence (DEC) among female higher education students in Serbia. The aim is to assess the extent of calibration between self-assessed and knowledge-based measures of DEC and to explore whether demonstrated competence and calibration differ by employment status and study level. The study applies a cross-sectional quantitative design using two complementary instruments: a self-assessment questionnaire and a knowledge-based test. The data originate from an online survey conducted between March and May 2025 among students in Serbian higher education institutions. The analysis focuses on the subsample of female students who completed both instruments (N = 62). The findings indicate a systematic tendency toward overestimation of DEC. Employed female students demonstrate higher objectively assessed competence, while Master's students show both higher demonstrated competence and smaller calibration gaps; however, these differences should be interpreted cautiously due to the overlap between employment status and study level in the subsample. The

[1] Corresponding author, e-mail: nevena.veselinovic@ien.bg.ac.rs
[2] E-mail: ivana.domazet@ien.bg.ac.rs
[3] E-mail: milena.lazic@ien.bg.ac.rs

results underline the importance of combining subjective and objective measures in the assessment of DEC and suggest that dual-assessment approaches can help educators and policymakers identify both competence gaps and self-assessment bias.

KEYWORDS: *digital entrepreneurial competence, calibration gap, self-assessment, knowledge assessment, female students, higher education, Serbia*

Introduction

The digital transformation of entrepreneurship has reshaped how entrepreneurial opportunities are identified, evaluated, and scaled (Prando et al., 2024). In a technology-driven global economy, digital platforms, data, and artificial intelligence (AI) increasingly influence both the feasibility of new ventures and the speed at which business models evolve (Figura et al., 2025; Lazic et al., 2025; Moro-Visconti, 2024; Štavljanin et al., 2017). In this context, the ability to navigate digital environments is no longer an auxiliary skill, but a core element of entrepreneurial capability (Pennetta et al., 2023; Prokopenko et al., 2024). Research on the role of AI and big data in entrepreneurship suggests that these technologies are expanding the "opportunity space" and redefining how entrepreneurs create, deliver, and capture value (Obschonka & Audretsch, 2020). Related work on digital transformation further emphasizes that organizations and individuals operate within increasingly complex digital ecosystems shaped by data, analytics, and interdependent technological infrastructures (Pappas et al., 2018).

As these shifts accelerate, DEC have emerged as a key concept in entrepreneurship education and related policy debates (Prendes-Espinosa et al., 2021). DEC refers to an integrated set of abilities that enable individuals to recognize digitally enabled opportunities, create value through digital technologies, collaborate in virtual contexts, and innovate through technology-enabled processes (Ivanović et al., 2025; Prendes-Espinosa et al., 2021). Importantly, DEC sits at the intersection of entrepreneurial and digital competence development, combining entrepreneurship-oriented value creation and initiative with the applied use of digital skills and tools (Bacigalupo et al., 2016; Vuorikari et al., 2022). This makes DEC particularly relevant for higher education, where curricula are increasingly expected to cultivate transversal competences that prepare students for digitally mediated work and entrepreneurial pathways (Bacigalupo et al., 2016; Vuorikari et al., 2022; Popović Šević et al., 2025).

Despite the growing importance of DEC, gender disparities remain significant in digital entrepreneurship (Gharagozloo et al., 2023). Women continue to be underrepresented in technology-intensive and high-growth entrepreneurial trajectories, with constraints that include unequal access to networks and resources, gendered expectations about technological aptitude, and structural barriers within innovation systems (Guzman & Kacperczyk, 2019; Ranga & Etzkowitz, 2010). These patterns are consistent with broader evidence that the digital economy does not automatically translate into equal inclusion: rather, it can reproduce existing inequalities if capability development, access to support structures, and opportunity recognition processes remain uneven.

Increasing attention to the gender dimensions of digital transformation has revealed how digitalization and digital competences intersect with women's inclusion and labor market outcomes, highlighting the practical relevance of digital skills for employability and participation in changing work environments (Jevtić et al., 2023; Mingaleva & Shironina, 2021). Complementary studies also address digital competence development through an inclusion lens, including gender and disability-related dimensions, contributing to a richer understanding of who benefits from digital transformation and under what conditions (Lazić et al., 2023). However, empirical evidence focusing specifically on female students' DEC, and especially studies using dual assessment and calibration to contrast demonstrated and perceived competence, remains limited, leaving educators with an incomplete basis for designing targeted, evidence-informed interventions.

This study addresses that gap by examining DEC among female students through a dual measurement perspective that distinguishes between demonstrated competence (knowledge-based assessment) and perceived competence (self-assessment). This distinction is important because perceived competence can shape motivation, learning choices, and career intentions (Jeno et al., 2021), while demonstrated competence reflects the concrete capability base that education programs aim to develop (Ponomariovienė et al., 2025). By jointly analyzing these dimensions, the paper provides a more actionable diagnostic picture of competence development in women's entrepreneurship education. Specifically, the study investigates the level and structure of DEC among female students, the extent to which perceived and demonstrated DEC align, and whether

systematic differences in this alignment are associated with relevant student characteristics.

The paper proceeds as follows. The next section reviews research on DEC frameworks, metacognition, and gender dimensions. The methodology section describes the dual-assessment design and sample. Results are then reported, followed by a discussion of implications for women's entrepreneurship education.

Literature Review

The concept and measurement of DEC have progressed alongside broader European competence frameworks. EntreComp conceptualizes entrepreneurship as a combination of knowledge, skills, and attitudes required to create value in diverse contexts (McCallum et al., 2018), while DigComp provides a structured view of citizens' digital competences (Lazic et al., 2024), including updated examples of knowledge, skills, and attitudes relevant to contemporary digital environments (Bacigalupo et al., 2016; Vuorikari et al., 2022). Building on these foundations, the EmDigital model explicitly bridges entrepreneurial and digital competence development and has been used to frame digital entrepreneurship as a competence-based construct relevant for education and policy, including the development of measurement approaches (Prendes-Espinosa et al., 2021).

Within this context, recent work has emphasized that DEC should be considered multidimensional and context-sensitive (Park & Kim, 2024), especially in higher education settings where students' learning pathways, exposure to digital tools, and entrepreneurial intentions can differ significantly. Simović and Domazet (2021) reviewed frameworks for measuring university students' digital competences and highlighted the diversity of approaches and the importance of contextualizing measurement instruments. In related work, Simović and Domazet (2023) offered a research roadmap and preliminary evidence on what drives students' DEC, reinforcing the view that competence development reflects both individual characteristics and learning or experience environments. Empirical studies commonly operationalize DEC around opportunity recognition, digital value creation, virtual collaboration, and technology-enabled innovation (Prendes-Espinosa et al., 2021; Simović & Domazet, 2023). Consistent with this, the present study adopts four DEC dimensions: opportunity identification and

business modelling, personal and professional digital competences, digital value creation and collaboration, and innovation and risk management.

Empirical evidence further suggests that DEC varies according to student characteristics and experiences. A pilot study focusing on opportunity identification as a component of DEC documented cross-country insights for university students in Kuwait and Serbia (Simović et al., 2022). More broadly, evidence on university students indicates that socio-demographic and experience-related factors, including employment status and related exposure to practice environments, are associated with differences in DEC levels (Simović et al., 2023). Complementary research using DigComp-based approaches has also been applied to women's entrepreneurship in Serbia, mapping competence levels across selected digital competence areas and indicating that targeted competence development remains relevant for women's participation in digitally mediated entrepreneurial pathways (Ivanović et al., 2021).

A second relevant strand concerns the metacognitive side of competence, namely how objectively demonstrated competences relate to self-assessed abilities. Research on the Dunning-Kruger effect shows that limited competence can be accompanied by inflated self-assessments, partly because the skills needed to perform well are often also needed to evaluate one's performance accurately (Kruger & Dunning, 1999; Dunning, 2011). In education, calibration, defined as the alignment between self-assessed and actual performance, is linked to learning choices, persistence, and effective skill development (Hacker et al., 2000). Poor calibration can lead students to underinvest in skill development or overestimate their readiness for advanced tasks, with implications for both learning outcomes and career decisions. Related synthesis evidence also shows that self-evaluations are systematically biased in predictable ways across contexts, which supports treating perceived competence as an analytically distinct dimension rather than a direct proxy for demonstrated competence (Zell & Krizan, 2014). These insights motivate dual-assessment designs that jointly measure perceived and demonstrated competence when evaluating DEC.

The gender dimension further strengthens the relevance of examining DEC among female students. Women remain underrepresented in technology-intensive entrepreneurship (Arvidsson, 2025) and may face constraints linked to access to resources and networks, gendered expectations, and structural barriers in innovation systems (Doargajudhur et al., 2026; Galmangodage et al., 2025; Guzman & Kacperczyk, 2019; Ranga

& Etzkowitz, 2010). In Serbia, recent evidence has examined how digitalization and skills relate to women's labor market inclusion and how gender intersects with digital competence development in inclusion-focused contexts (Jevtić et al., 2023; Lazić et al., 2023). Broader discussions of digital workplace transformation similarly underline that women can face distinct challenges in adapting to digitalized work environments (Mingaleva & Shironina, 2021). In parallel, research on women's economic empowerment points to the relevance of financial inclusion, including its digital dimension, as part of the broader ecosystem that can support women's entrepreneurship and economic participation (Antonijević et al., 2024; Abdallah et al., 2025). Evidence on women entrepreneurs also indicates that entrepreneurship outcomes depend on a mix of technical, interpersonal, and planning-related competences, reinforcing the value of competence-based diagnostics in women's entrepreneurship education (Marín et al., 2024).

Taken together, the literature points to two limitations. First, many DEC studies rely primarily on self-report measures, which may not capture demonstrated competence. Second, fewer studies focus on female students and explicitly examine whether perceived and demonstrated DEC align, and whether this alignment varies by study level and employment-related experience. These gaps motivate a dual-assessment approach that distinguishes perceived from demonstrated competence and quantifies calibration.

Educational progression from the Bachelor to Master's level typically entails deeper engagement with subject matter, more complex analytical tasks, and greater opportunities for reflective learning and feedback. Thus, Master's-level study may be associated with stronger domain-specific knowledge as well as more developed metacognitive awareness, that is, the ability to appraise one's own capabilities more accurately (Dunning, 2011). Accordingly, Master's students may exhibit both higher demonstrated competence and more accurate calibration between perceived and actual abilities. In parallel, employment alongside studies can provide practical exposure to digital tools and business processes, which may be associated with higher competence levels and more realistic self-evaluation (Simović et al., 2023; Slijepčević & Krstić, 2020).

Addressing these gaps, the present study examines DEC among female students using a dual measurement perspective that distinguishes demonstrated competence (knowledge-based assessment) from perceived

competence (self-assessment), quantifies the calibration gap, and explores how objective DEC and calibration patterns vary by study level and employment status. These theoretical considerations lead to four testable hypotheses.

Building on the above literature, the hypotheses are formulated to reflect competence calibration dynamics and the expected differences by experience and educational level:

H1: Female students, on average, overestimate their DEC, such that the alibration gap is positive.

H2: Employed female students demonstrate higher objectively assessed DEC than non-employed female students.

H3: Female students enrolled in Master's programmes exhibit higher objectively assessed DEC than female students enrolled in Bachelor-level programmes.

H4: Female students enrolled in Master's programmes exhibit smaller calibration gaps than female students enrolled in Bachelor-level programmes.

Methodology

The study uses a cross-sectional quantitative design. DEC is measured with two complementary instruments: a knowledge-based assessment (KA), which captures objectively demonstrated competence, and a self-assessment questionnaire (SA), which captures students perceived competence. Using both instruments allows estimation of the calibration gap between perceived and demonstrated competence, which is the central outcome variable of the analysis.

The data originate from a larger online survey on DEC conducted among students in Serbian higher education. The survey was administered between March and May 2025 and distributed across public and private higher education institutions in Serbia, targeting students enrolled in Bachelor's and Master's programmes. Data collection was organized to ensure broad institutional representation, and the gender composition of the overall sample was actively monitored throughout the survey period.

This analysis focuses on the subsample of female students who completed both KA and SA instruments (N = 62). Limiting the analysis to

female participants allows for a focused examination of competence and calibration patterns among women in higher education. This focus is motivated by evidence of gender gaps in high-growth entrepreneurship and access to external finance (Guzman & Kacperczyk, 2019), as well as evidence that women's digital knowledge and skills are relevant for inclusion and employment outcomes in a digitalizing labor market (Jevtić et al., 2023). Table 1 summarizes the characteristics of the female analytical sample. Most respondents are enrolled in Bachelor's programmes (82.3%), while 17.7% are in a Master's programme. Overall, 40.3% of respondents are employed alongside their studies. Importantly, employment status and study level overlap in this subsample: all Master's students report being employed, whereas among Bachelor's students 27.5% are employed. Accordingly, study-level comparisons (Bachelor's vs. Master's) are interpreted as descriptive contrasts rather than estimates of isolated educational effects. Percentages reported in Table 1 are calculated relative to the full female sample unless stated otherwise.

Table 1: Sample characteristics

Characteristic	**Category**	**n**	**% of sample**
Level of study	Bachelor	51	82.3
	Master	11	17.7
Employment status (overall)	Unemployed	37	59.7
	Employed	25	40.3
Employment by level of study	Unemployed (Bachelor)	37	59.7
	Employed (Bachelor)	14	22.6
	Unemployed (Master)	0	0.0
	Employed (Master)	11	17.7
Age (years)	Mean (SD)	23.48 (5.79)	-
	Range (min–max)	18 - 46	-

Source: Authors' calculation

Item-level responses from SA and KA were aggregated at the respondent level using a unique email identifier. In the KA, responses were scored using an answer key (1 if the selected option matched the key, 0 otherwise), and demonstrated competence was computed as the respondent's mean score across items (0-1). To ensure comparability with SA, the KA score was linearly rescaled to the 1-4 metric:

$$KA_i^{scaled} = 1 + 3 \times KA_i \quad (1)$$

Perceived competence was computed as the mean of SA item responses (1-4). Dimension-specific scores for both SA and KA were computed analogously using the four DEC dimensions: (1) opportunity identification and business modelling (Dim 1), (2) personal/professional digital competences (Dim 2), (3) digital value creation and collaboration (Dim 3), and (4) innovation and risk management (Dim 4).

The calibration gap was operationalized as:

$$GAP_i = SA_i - KA_i^{scaled} \quad (2)$$

Positive values indicate overestimation and negative values indicate underestimation.

Hypothesis testing follows the measurement logic of the study. H1 is evaluated using a one-sample t-test of whether the mean overall calibration gap differs from zero. H2 is evaluated by comparing objectively assessed DEC (KA, overall and by dimension) across employment status (employed vs. unemployed). H3 and H4 are evaluated by comparing KA scores and calibration gaps, respectively, across study level (Bachelor vs. Master's). Given the overlap between study level and employment status in the female subsample, study-level comparisons are interpreted as descriptive contrasts. As an ancillary check, Bachelor-Master comparisons were also repeated within the employed-only subsample. Alongside the main parametric tests, distributional assumptions were assessed using the Shapiro-Wilk normality test and Levene's test for homogeneity of variance. As robustness checks, between-group results were cross-checked using Mann-Whitney U tests. Effect sizes were reported as Cohen's d with 95% confidence intervals, interpreted using conventional benchmarks (0.2 small, 0.5 medium, 0.8 large).

All statistical tests are two-tailed and evaluated at the 5% significance level, with effect sizes reported to complement p-values. Analyses were conducted in Stata 14. Participation in the online survey was voluntary and anonymous, and respondents provided informed consent prior to completing the instruments.

Results

Table 2 reports descriptive statistics for KA, SA, and the calibration gaps. For KA, mean scores across the four DEC dimensions are approximately 2.0-2.2 on the 1-4 scale (Dim 1 = 2.09; Dim 2 = 2.20; Dim 3 = 2.21; Dim 4 = 2.01), with an overall KA mean of 2.12 (SD = 0.51), indicating moderate levels of objectively tested DEC among the female students. In contrast, SA means are consistently higher, ranging from 2.58 to 2.83 across dimensions, with an overall SA mean of 2.72 (SD = 0.56). Calibration gaps are positive in all dimensions (0.57-0.72 points) and average 0.60 (SD = 0.71). The largest gaps emerge in Dim 1 (opportunity identification and business modelling; Gap = 0.72) and Dim 3 (digital value creation and collaboration; Gap = 0.61), while the smallest gap is observed in Dim 2 (personal and professional digital competences; Gap = 0.57). Although a few students slightly underestimate their competences (negative minimum values), the overall pattern indicates systematic overestimation of DEC.

Table 2: Descriptive Statistics for DEC scores

Variable	Mean	SD	Min	Max
KA				
Dim 1	2.09	0.79	1.00	4.00
Dim 2	2.20	0.48	1.00	3.18
Dim 3	2.21	0.64	1.00	3.50
Dim 4	2.01	0.59	1.00	3.25
KA Total	**2.12**	**0.51**	**1.07**	**3.13**
SA				
Dim 1	2.81	0.50	1.83	4.00
Dim 2	2.77	0.54	1.18	3.64
Dim 3	2.83	0.68	1.00	4.00
Dim 4	2.58	0.66	1.00	4.00
SA Total	**2.72**	**0.56**	**1.16**	**3.67**
Calibration gap (SA - KA)				
Dim 1	0.72	0.89	-1.17	2.33
Dim 2	0.57	0.62	-0.82	1.82
Dim 3	0.61	0.85	-1.17	2.58
Dim 4	0.57	0.88	-1.56	2.38
Gap Total	**0.60**	**0.71**	**-0.80**	**2.11**

Source: Authors' calculation

Table 3 compares DEC scores between female students who are employed alongside their studies and those who are not. Employed students obtain significantly higher demonstrated competence scores overall (KA Total: M = 2.31, SD = 0.52) compared to unemployed students (M = 1.99, SD = 0.48; t = 2.47, p = 0.016). At the dimensional level, this advantage is most pronounced in Dim 3 (digital value creation and collaboration; M = 2.50 vs. M = 2.02, p = 0.003) and Dim 4 (innovation, risk, and improvement by digital technology; M = 2.19 vs. M = 1.89, p = 0.048), with a marginal difference in Dim 1 (opportunity identification and business modelling; p = 0.054).

In contrast, self-assessed competence does not differ significantly by employment status (SA Total: M = 2.74 vs. M = 2.71, p = 0.837). Similarly, the overall calibration gap does not vary significantly between employed and unemployed students (Gap Total: M = 0.43 vs. M = 0.72, p = 0.121), although unemployed students show a tendency toward larger overestimation. A significant difference does emerge for the Dim 4 calibration gap (M = 0.29 vs. M = 0.76, p = 0.040), indicating that employed women exhibit smaller calibration gaps in innovation- and technology-related competences. To maintain focus on the most theoretically relevant contrasts and avoid overloading the presentation with multiple tests, Table 3 reports KA scores for all four dimensions but only total SA and gap scores, plus the single dimensional gap (Dim 4) that shows a statistically significant difference by employment status.

Table 3: Comparison of DEC scores by employment status

Variable	Unemployed	Employed	t	p
	M (SD)	M (SD)		
KA Total	**1.99 (0.48)**	**2.31 (0.52)**	**-2.47**	**0.016***
Dim 1	1.93 (0.77)	2.32 (0.78)	-1.95	0.054*
Dim 2	2.15 (0.49)	2.28 (0.46)	-1.02	0.310
Dim 3	2.02 (0.58)	2.50 (0.65)	-3.07	0.003*
Dim 4	1.89 (0.53)	2.19 (0.63)	-2.02	0.048*
SA Total	**2.71 (0.59)**	**2.74 (0.53)**	**-0.21**	**0.837**
Gap Total	**0.72 (0.69)**	**0.43 (0.72)**	**1.57**	**0.121**
Dim 4	0.76 (0.79)	0.29 (0.95)	2.10	0.040*

Note. * $p < 0.05$ (two-tailed).

Source: Authors' calculation

Table 4 compares DEC scores between Bachelor's and Master's students. Master's students achieve significantly higher demonstrated competence scores overall (KA Total: M = 2.41, SD = 0.57) compared to Bachelor students (M = 2.06, SD = 0.49; t = 2.13, p = 0.037). This difference is particularly evident in Dim 1 (opportunity identification and business modelling; p = 0.018) and Dim 3 (digital value creation and collaboration; p = 0.010), with a marginal difference in Dim 4 (p = 0.056).

Self-assessed competence does not differ significantly by study level (SA Total: p = 0.449). However, the overall calibration gap is substantially smaller among Master's students (M = 0.19, SD = 0.64) than among Bachelor students (M = 0.69, SD = 0.70; p = 0.034). Significant differences in calibration gaps also emerge in Dim 1 (p = 0.022), Dim 3 (p = 0.024), and Dim 4 (p = 0.011), indicating that Master's students combine higher objectively assessed DEC with more realistic self-evaluations. Because all Master's students in this subsample are employed, whereas only a minority of Bachelor's students are employed, study-level differences should be interpreted as descriptive contrasts that may reflect both educational progression and employment-related experience.

Table 4: Comparison of DEC scores by study level

Variable	Bachelor	Master	t	p
	M (SD)	M (SD)		
KA Total	**2.06 (0.49)**	**2.41 (0.57)**	**-2.13**	**0.037***
Dim 1	1.98 (0.73)	2.59 (0.89)	-2.43	0.018*
Dim 2	2.20 (0.48)	2.19 (0.49)	0.08	0.935
Dim 3	2.12 (0.61)	2.66 (0.64)	-2.65	0.010*
Dim 4	1.94 (0.55)	2.31 (0.68)	-1.95	0.056
SA Total	**2.75 (0.58)**	**2.60 (0.44)**	**0.76**	**0.449**
Gap Total	**0.69 (0.70)**	**0.19 (0.64)**	**2.17**	**0.034***
Dim 1	0.84 (0.83)	0.17 (1.00)	2.35	0.022*
Dim 3	0.73 (0.84)	0.09 (0.76)	2.32	0.024*
Dim 4	0.70 (0.85)	-0.04 (0.81)	2.64	0.011*

Note. * $p < 0.05$ (two-tailed).

Source: Authors' calculation

All Master's students in the sample are employed (Table 1), whereas only 27.5% of Bachelor students hold jobs. This overlap implies that the observed study-level differences may reflect both educational progression

and employment-related experience. Accordingly, Bachelor-Master comparisons are interpreted as descriptive contrasts rather than isolated educational effects. Notably, Master's students exhibit smaller calibration gaps while showing no statistically significant differences in self-assessed competence (SA Total) (Table 4), which is consistent with the possibility of metacognitive gains beyond employment experience alone; however, this interpretation remains tentative given the sample structure.

To partially address this overlap, we conducted an ancillary employed-only comparison between employed Master's students (n = 11) and employed Bachelor students (n = 14) (Table 4a). In this employed-only subsample, Master's students show a modest advantage in demonstrated competence (KA Total: M = 2.41, SD = 0.57 vs. M = 2.23, SD = 0.49), but this difference is not statistically significant (t = 0.87, p = 0.394; Mann-Whitney z = 0.99, p = 0.323; Cohen's d = 0.35). The calibration gap is also numerically smaller among employed Master's students (Gap Total: M = 0.19, SD = 0.64) than among employed Bachelor students (M = 0.62, SD = 0.75), although this contrast does not reach conventional significance levels given the small group sizes (t = 1.50, p = 0.148; Mann–Whitney z = 1.48, p = 0.139; Cohen's d = -0.60). Overall, the employed-only comparison is directionally consistent with the main study-level patterns, especially for calibration, but inference is limited by low statistical power and by the non-independence of education and employment in this subsample.

Table 4a: Ancillary employed-only comparison of DEC outcomes

Variable	Bachelor (employed)	Master (employed)	t	p	z (Mann-Whitney)	p
	M (SD)	M (SD)				
KA Total	2.23 (0.49)	2.41 (0.57)	-0.87	0.394	-0.99	0.323
Gap Total	0.62 (0.75)	0.19 (0.64)	1.50	0.148	1.48	0.139

Note. Two-tailed tests. z refers to the Mann-Whitney U test.

Source: Authors' calculation

Table 5 summarizes robustness checks and complementary statistics. Shapiro-Wilk tests do not indicate departures from normality for the key variables (Panel A). Levene's tests do not suggest heterogeneity of variances for KA_scaled and Gap_overall (Panel A). Mann-Whitney U tests confirm the main patterns. KA_scaled differs by employment status (z = -2.29, p = 0.022) and Gap_overall differs by study level (z = 2.23, p =

0.026), while the study-level difference in KA_scaled is borderline (z = -1.96, p = 0.050) (Panel B). Effect sizes are in the medium to medium-large range (Panel C). The mean overall calibration gap is significantly greater than zero (t = 6.65, p < 0.001), supporting systematic overestimation in the sample (Panel D).

Table 5: Robustness checks and effect sizes

Panel A: Normality and homogeneity of variance				
Variable	Shapiro-Wilk W	p	Levene's W	p
KA_scaled	0.98	0.41	0.77	0.38
SA_overall	0.98	0.41	-	-
Gap_overall	0.99	0.71	0.37	0.54

Panel B: Non-parametric tests (Mann-Whitney U)			
Comparison	Variable	z	p
Employment (Unemp. vs Emp.)	KA_scaled	-2.29	0.022*
Study level (Bachelor vs Master)	KA_scaled	-1.96	0.050
Study level (Bachelor vs Master)	Gap_overall	2.23	0.026*

Panel C: Effect sizes (Cohen's d)				
Comparison	Variable	d	95% CI	Size
Employment (Unemp. vs Emp.)	KA_scaled	0.64	[0.12, 1.16]	Medium
Study level (Bachelor vs Master)	KA_scaled	0.71	[0.04, 1.37]	Medium-large
Study level (Bachelor vs Master)	Gap_overall	0.72	[0.05, 1.38]	Medium-large

Panel D: One-sample t-test (Is gap ≠ 0?)				
Variable	Mean	t	df	p
Gap_overall	0.60	6.65	61	<0.001***

Note: * p < 0.05, *** p < 0.001. Effect size interpretation: 0.2 = small, 0.5 = medium, 0.8 = large (Cohen, 1988).

Source: Authors' calculation

Taken together, the results support H1 and H2 and provide evidence broadly consistent with H3 and H4. H1 is supported by a positive overall calibration gap (Gap_overall, M = 0.60; t = 6.65, p < 0.001; Tables 2 and 5). H2 is supported by higher demonstrated competence among employed

students (KA Total, M = 2.31 vs. 1.99, p = 0.016; Table 3), and the non-parametric test corroborates this difference (Table 5, Panel B). Study-level differences are directionally consistent with H3 and H4. Master's students show higher KA scores and smaller calibration gaps than Bachelor students (Table 4). The study-level gap difference remains significant in the Mann-Whitney test (Table 5, Panel B), whereas the study-level KA difference is borderline in the non-parametric check (p = 0.050). However, because all Master's students in this subsample are employed, these Bachelor-Master comparisons are interpreted as descriptive contrasts rather than isolated educational effects. An employed-only ancillary comparison (Table 4a) shows the same directions, especially for calibration, but it is underpowered for definitive inference.

Discussion

The finding that female students systematically overestimate their DEC (H1) is consistent with metacognitive accounts emphasized in the Dunning-Kruger literature (Kruger & Dunning, 1999; Dunning, 2011) and extends evidence on self-assessment miscalibration to the domain of DEC. The positive calibration gap (M = 0.60) indicates that female students' self-assessed capabilities exceed their objectively demonstrated knowledge by more than half a scale point on average. This pattern aligns with prior evidence that self-evaluations show only moderate accuracy and are susceptible to bias and contextual moderators (Zell & Krizan, 2014; Zell et al., 2020). Notably, the magnitude and consistency of overestimation across all four DEC dimensions suggest that calibration challenges may be particularly salient in this competence domain. The largest gaps emerged in opportunity identification and business modeling (Dim 1: Gap = 0.72) and digital value creation and collaboration (Dim 3: Gap = 0.61), competence areas central to entrepreneurial value creation that may reflect uneven curricular emphasis or differential exposure in undergraduate business programs. These findings also align with recent work treating DEC as multidimensional and context-sensitive (Simović & Domazet, 2023), suggesting that calibration may vary systematically across distinct DEC facets.

The association between employment status and demonstrated competence (H2) is consistent with the contemporary literature (Ivanović et al., 2025) and aligns with evidence showing that socio-demographic and

experience-related factors significantly shape DEC levels (Simović et al., 2023). Employed students achieved significantly higher objectively assessed DEC, with the strongest advantages in digital value creation and collaboration (Dim 3) and innovation, risk, and improvement (Dim 4), suggesting that work experience provides domain-specific exposure to digital tools and collaborative processes rather than broad-based competence gains. However, employment was not associated with smaller overall calibration gaps, although employed students showed more accurate calibration in innovation and technology-related competence (Dim 4). This indicates that workplace experience may improve metacognitive accuracy in directly applicable domains without generalizing across all DEC facets. In contrast, Master's-level students exhibited smaller calibration gaps across multiple dimensions, implying that graduate-level study and employment may foster metacognitive accuracy through different mechanisms.

The finding that Master's students demonstrate higher objectively assessed DEC (H3) and substantially smaller calibration gaps (H4) is consistent with the view that increased expertise and exposure to performance feedback can support more accurate self-assessment, while miscalibration reflects metacognitive limits (Dunning, 2011). Master's students scored higher on demonstrated competence (KA Total: $M = 2.41$ vs. 2.06; $p = 0.037$) and showed markedly smaller overall calibration gaps ($M = 0.19$ vs. 0.69; $p = 0.034$), with gap differences evident in three of four dimensions, especially Dim 3, where calibration was close to zero (Gap = 0.09). While some recent evidence reports higher digital entrepreneurial competencies among Bachelor's students (Ivanović et al., 2025), the present results should be interpreted in light of sample composition: all Master's students in the analyzed subsample were employed, conflating study level with work experience. Restricting the comparison to employed respondents yields directionally consistent results, although limited statistical power precludes firm conclusions.

More broadly, the results highlight calibration accuracy as a distinct outcome alongside demonstrated and perceived competence. Self-assessed competence did not differ significantly by either employment status or study level, whereas objectively assessed competence and calibration gaps did, reinforcing that perceived competence should be treated as analytically distinct rather than a proxy for demonstrated competence (Zell & Krizan, 2014).

The findings have direct implications for entrepreneurship educators and curriculum designers. The systematic overestimation among female students suggests that courses should include elements that improve calibration accuracy, not only competence. Practical options include low-stakes formative tests with clear performance criteria, rapid feedback, and structured reflection in which students compare self-ratings with objective benchmarks. Because gaps were largest in opportunity identification and business modeling and in digital value creation and collaboration, these domains warrant more explicit instruction, repeated practice, and feedback.

Smaller gaps among Master's students suggest that learning environments with intensive feedback and project-based work may support more realistic self-evaluation. However, since Master's students in this subsample were also employed, the differences should be interpreted cautiously. For students, calibration accuracy matters for career planning and entrepreneurial entry because realistic self-assessment helps identify skill deficits early and target learning investments. Finally, the dual-assessment approach offers a simple diagnostic tool. Using both knowledge tests and self-assessments allows educators to detect competence deficits and calibration bias and to tailor interventions by DEC dimension (Guzman & Kacperczyk, 2019; Ivanović et al., 2021; Jevtić et al., 2023; Simović & Domazet, 2023).

Conclusion

This study demonstrates that female students tend to systematically overestimate their DEC, while objectively demonstrated competence is higher among employed students and those enrolled in Master's studies. Beyond these group differences, a key contribution of the study lies in showing that calibration accuracy represents a distinct analytical outcome, conceptually and empirically separate from both perceived and demonstrated competence. The results suggest that students may possess similar levels of knowledge or self-confidence yet differ substantially in how accurately they judge their own capabilities. By jointly measuring SA and KA DEC and explicitly quantifying the calibration gap between them, the dual-assessment design offers a practical and theoretically grounded diagnostic framework for entrepreneurship and digital skills education. It provides evidence that competence development should be evaluated not

only in terms of what students know and what they believe they know, but also in terms of how well these two perspectives align.

At the same time, the findings must be interpreted considering several limitations. The sample size is relatively small and restricted to female students, which is appropriate for the study's analytical focus but limits broader generalizability. The cross-sectional design precludes causal inference regarding the effects of employment status or graduate-level education on either competence or calibration. Moreover, in this subsample all Master's students were also employed, which conflates study level with work experience and prevents disentangling educational effects from those related to labor-market exposure. Measurement-related constraints should also be acknowledged. Although rescaling procedures enhance comparability between KA and SA measures, the observed calibration gap remains sensitive to test difficulty, the breadth and balance of item coverage across DEC dimensions, and potential heterogeneity in how respondents interpret self-assessment statements.

Future research can extend these findings in several important directions. Longitudinal designs would allow examination of how calibration accuracy develops over time and whether improvements are associated with specific educational milestones, instructional methods, or workplace experiences. Experimental and quasi-experimental studies could test targeted pedagogical interventions, such as structured feedback, peer benchmarking, formative assessment, and reflective calibration training, particularly in competence dimensions where miscalibration is most pronounced. Larger and more diverse samples should include male students, multiple institutions, and cross-country settings to assess the robustness and contextual sensitivity of calibration patterns. Future work should also link calibration accuracy to downstream outcomes, such as entrepreneurial intentions, academic performance, and early venture behavior, to clarify when miscalibration primarily acts as a barrier to learning and effective decision-making, and when it may reflect adaptive confidence in early-stage entrepreneurial development.

Acknowledgments

The research presented in this paper was funded by the Ministry of Science, Technological Development and Innovation of the Republic of Serbia under contract number 451-03-33/2026-03.

References

[1] **Abdallah, F., Antonijević, M., & Domazet, I.** (2025a). Determinants of women's financial inclusion: Evidence from the Gulf and the Western Balkan region. *Journal of Women's Entrepreneurship and Education*, (3-4), 95-112. https://doi.org/10.28934/jwee25.34.pp95-112

[2] **Antonijević, M., Domazet, I., Kojić, M., & Simović, V**. (2024). Financial inclusion - A driving force for women's entrepreneurship development. *Journal of Women's Entrepreneurship and Education*, (3-4), 73-92. https://doi.org/10.28934/jwee24.34.pp73-92

[3] **Arvidsson, H. G.** (2025). Empowered but Undersupported: Female Entrepreneurship in the IT Industry across the Nordic and Baltic Regions. *Zenodo (CERN European Organization for Nuclear Research)*. https://doi.org/10.5281/zenodo.15383996

[4] **Bacigalupo, M., Kampylis, P., Punie, Y., & Van den Brande, G.** (2016). *EntreComp: The Entrepreneurship Competence Framework. Publications Office of the European Union*. https://doi.org/10.2791/593884

[5] **Doargajudhur, M., Hosanoo, Z., Rughoobur-Seetah, S., & Lichy, J.** (2026). Digital entrepreneurship and gendered boundaries: Technology, work–life conflict, and well-being. *Gender, Work & Organization*. https://doi.org/10.1111/gwao.70090

[6] **Dunning, D.** (2011). The Dunning–Kruger effect: On being ignorant of one's own ignorance. In *Advances in experimental social psychology* (pp. 247–296). Elsevier. https://doi.org/10.1016/b978-0-12-385522-0.00005-6

[7] **Figura, M., Juracka, D., & Imppola, J.** (2025). From Idea to Impact: The role of Artificial intelligence in the transformation of business models. *Management Dynamics in the Knowledge Economy, 13*(2), 120–147. https://doi.org/10.2478/mdke-2025-0008

[8] **Galmangodage, L., Yu, A., & Costanzo, L.** (2025). Not ready yet: Why accelerators may not close the gender gap in entrepreneurship as expected. *Gender, Work & Organization*. https://doi.org/10.1111/gwao.13238

[9] **Gharagozloo, M. M. M., Bajestani, M. F., Gharagozloo, A. M., Sedeh, A. A., & Askarzadeh, F.** (2023). The role of digitalization in decreasing gender gap in opportunity driven entrepreneurship. *Information Technology for Development, 29*(4), 645–664. https://doi.org/10.1080/02681102.2023.2237470

[10] **Guzman, J., & Kacperczyk, A.** (2019). Gender gap in entrepreneurship. *Research Policy*, *48*(7), 1666–1680. https://doi.org/10.1016/j.respol.2019.03.012

[11] **Hacker, D. J., Bol, L., Horgan, D. D., & Rakow, E. A.** (2000). Test prediction and performance in a classroom context. *Journal of Educational Psychology*, *92*(1), 160–170. https://doi.org/10.1037/0022-0663.92.1.160

[12] **Ivanović, D., Radenković, S. D., Hanić, H., Simović, V., & Kojić, M.** (2025). A novel approach to measuring digital entrepreneurial competences among university students. *The International Journal of Management Education*, *23*(2), 101180. https://doi.org/10.1016/j.ijme.2025.101180

[13] **Ivanovic, D., Simovic, V., Domazet, I., & Antonijevic, M**. (2021). Average matching levels for two digcomp competence areas of the female entrepreneurs in Serbia. *Journal of Women's Entrepreneurship and Education*, (3-4), 42–60. https://doi.org/10.28934/jwee21.34.pp42-60

[14] **Jeno, L. M., Nylehn, J., Hole, T. N., Raaheim, A., Velle, G., & Vandvik, V.** (2021). Motivational determinants of students' academic functioning: the role of autonomy-support, autonomous motivation, and perceived competence. *Scandinavian Journal of Educational Research, 67*(2), 194–211. https://doi.org/10.1080/00313831.2021.1990125

[15] **Jevtić, B., Vucekovic, M., & Tasić, S.** (2023). The effects of digitalization and skills on women's labor market inclusion - Serbian gap study. *Journal of Women's Entrepreneurship and Education*, 58–75. https://doi.org/10.28934/jwee23.pp58-75

[16] **Kruger, J., & Dunning, D**. (1999). Unskilled and unaware of it: How difficulties in recognizing one's own incompetence lead to inflated self-assessments. *Journal of Personality and Social Psychology*, *77*(6), 1121–1134. https://doi.org/10.1037/0022-3514.77.6.1121

[17] **Lazic, M., Simovic, V., & Domazet, I.** (2024). Digital competences and disability: a contribution to a more inclusive digital society. *Universal Access in the Information Society, 24*(2), 1623–1642. https://doi.org/10.1007/s10209-024-01165-4

[18] **Lazic, M., Simovic, V., Domazet, I., & Abdallah, F.** (2025). Predictive Insights into Digital Competencies: A Data-Driven Approach to Inclusion. *Journal of Technology in Human Services, 43*(4), 271–300. https://doi.org/10.1080/15228835.2025.2491344

[19] **Lazić, M., Vukmirović, V., Banović, J., Simović, V., & Paunović, M.** (2023). Digital competences as a precondition for an inclusive digital economy - is there a gender gap among persons with disabilities in Serbia? *Journal of Women's Entrepreneurship and Education*, (1-2), 51–71. https://doi.org/10.28934/jwee23.12.pp51-71

[20] **McCallum, E., Weicht, R., Mcmullan, L., & Price, A.** (2018). *EntreComp into Action - Get inspired, make it happen: A user guide to the European Entrepreneurship Competence Framework.* JRC Publications Repository. https://doi.org/10.2760/574864

[21] **Mingaleva, Z., & Shironina, E.** (2021). Gender aspects of digital workplace transformation. *Journal of Women's Entrepreneurship and Education*, (1-2), 1–17. https://doi.org/10.28934/jwee21.12.pp1-17

[22] **Moro-Visconti, R.** (2024). Digital networking and artificial intelligence-driven startups. In *Startup valuation* (pp. 241–291). Springer Nature Switzerland. https://doi.org/10.1007/978-3-031-77469-0_6

[23] **Obschonka, M., & Audretsch, D. B.** (2019). Artificial intelligence and big data in entrepreneurship: A new era has begun. *Small Business Economics*, *55*(3), 529–539. https://doi.org/10.1007/s11187-019-00202-4

[24] **Pappas, I. O., Mikalef, P., Giannakos, M. N., Krogstie, J., & Lekakos, G.** (2018). Big data and business analytics ecosystems: Paving the way towards digital transformation and sustainable societies. *Information Systems and E-Business Management*, *16*(3), 479–491. https://doi.org/10.1007/s10257-018-0377-z

[25] **Park, J., & Kim, S.** (2025). Entrepreneurial Competencies in the Era of Digital Transformation: A Systematic Literature review. *Digital, 5*(4), 46. https://doi.org/10.3390/digital5040046

[26] **Pavlovic, D., Bjelica, D., & Domazet, I.** (2019). What characteristics in the youth labour market of Serbia are likely to result in employment? *Stanovnistvo*, *57*(2), 35- 47. https://doi.org/10.2298/stnv190823006p

[27] **Pennetta, S., Anglani, F., & Mathews, S.** (2023). Navigating through entrepreneurial skills, competencies and capabilities: a systematic literature review and the development of the entrepreneurial ability model. *Journal of Entrepreneurship in Emerging Economies, 16*(4), 1144–1182. https://doi.org/10.1108/jeee-09-2022-0257

[28] **Ponomariovienė, J., Jakavonytė-Staškuvienė, D., & Torterat, F.** (2025). Implementing Competency-Based Education Through the Personalized Monitoring of Primary Students' Progress and Assessment. *Education Sciences, 15*(2), 252. https://doi.org/10.3390/educsci15020252

[29] **Popović Šević, N., Šević, A., Slijepčević, M., & Krstić, J.** (2025). AI adoption in higher education: Exploring attitudes and perceived benefits between users and non-users. *Online Journal of Communication and Media Technologies*, *15*(4), Article e202528. https://doi.org/10.30935/ojcmt/17246

[30] **Prando, L. T., Schmitt, J., De Souza Mendonça, A. K., Rosa, F. S., Lunkes, R. J., Bornia, A. C., & De Andrade, D. F.** (2024). Entrepreneurial potential in digital transformation: scale development using item response theory. *European Journal of Innovation Management, 28*(7), 2784–2814. https://doi.org/10.1108/ejim-06-2024-0727

[31] **Prendes-Espinosa, P., Solano-Fernández, I. M., & García-Tudela, P. A.** (2021). EmDigital to promote digital entrepreneurship: The relation with open innovation. *Journal of Open Innovation: Technology, Market, and Complexity*, *7*(1), 63. https://doi.org/10.3390/joitmc7010063

[32] **Prokopenko, O., Järvis, M., Bielialov, T., Omelyanenko, V., & Malheiro, T.** (2024). The future of entrepreneurship: Bridging the innovation skills gap through digital learning. In *Innovations in industrial engineering III* (pp.

206–230). Springer Nature Switzerland. https://doi.org/10.1007/978-3-031-61582-5_18

[33] **Ranga, M., & Etzkowitz, H**. (2010). Athena in the world of techne: The gender dimension of technology, innovation and entrepreneurship. *Journal of Technology Management & Innovation*, *5*(1). https://doi.org/10.4067/s0718-27242010000100001

[34] **Reina Marín, Y., Sánchez Bardales, E., Carrasco Rituay, A. M., Cruz Caro, O., & Chávez Santos, R.** (2024). Empowering entrepreneurial success through the development of interpersonal skills and business plans in women entrepreneurs. *Journal of Women's Entrepreneurship and Education*, (3-4), 249-276. https://doi.org/10.28934/jwee24.34.pp249-276

[35] **Simović, V. M., & Domazet, I. S.** (2021). An overview of the frameworks for measuring the digital competences of college students: A European perspective. In T. Niemann et al. (Eds.), *Stagnancy Issues and Change Initiatives for Global Education in the Digital Age* (pp. 259–282). IGI Global. https://doi.org/10.4018/978-1-7998-4993-3.ch012

[36] **Simović, V. M., & Domazet, I. S**. (2023). What drives the levels of digital entrepreneurial competences of university students? A research roadmap and preliminary results. In A. Dias Daniel & C. I. Fernandes (Eds.), *Female Entrepreneurship as a Driving Force of Economic Growth and Social Change* (pp. 55–72). IGI Global. https://doi.org/10.4018/978-1-6684-7669-7.ch004

[37] **Simović, V., Domazet, I., Bhagat, R., Sarhan, H., & Ivanović, D.** (2022). Identification of opportunities as the component of digital entrepreneurial competences of university students: A pilot study in Kuwait and Serbia. In *Proceedings of the 6th International Conference on E-Commerce, E-Business and E-Government (ICEEG 2022)*. ACM. https://doi.org/10.1145/3537693.3537724

[38] **Simovic, V., Domazet, I., Bugarcic, M., Safi, M., Sarhan, H., Bhagat, R., & Bradic Martinovic, A.** (2023). The association of socio-demographic characteristics of university students and the levels of their digital entrepreneurial competences. *Heliyon*, *9*(10). https://doi.org/10.1016/j.heliyon.2023.e20897

[39] **Slijepcević, M., & Krstić, J. (2019).** Organizational culture and perceived effectiveness: A case study of an insurance company. *Management:Journal of Sustainable Business and Management Solutions in Emerging Economies*. https://doi.org/10.7595/management.fon.2019.0019

[40] **Štavljanin, V., Cvijović, J., & Kostić-Stanković, M.** (2017). Research of indirect advertising in video game industry. *Industrija*, *45*(4), 113–132. https://doi.org/10.5937/industrija45-16065

[41] **Vuorikari, R., Kluzer, S., & Punie, Y. (2022).** *DigComp 2.2: The Digital Competence Framework for Citizens* (EUR 31006 EN). Publications Office of the European Union. https://doi.org/10.2760/115376

[42] **Zell, E., & Krizan, Z.** (2014). Do people have insight into their abilities? A metasynthesis. *Perspectives on Psychological Science*, *9*(2), 111–125. https://doi.org/10.1177/1745691613518075

[43] **Zell, E., Strickhouser, J. E., Sedikides, C., & Alicke, M. D.** (2020). The better-than-average effect in comparative self-evaluation: A comprehensive review and meta-analysis. *Psychological Bulletin*, *146*(2), 118–149. https://doi.org/10.1037/bul0000218

Article history: Received: January 22, 2026

Accepted: May 6, 2026

First Online: May 7, 2026