

Developing to sustain: how informal learning shapes university students' future careers

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Abstract

Purpose – The growing emphasis on sustainable career ecosystems highlights the need for lifelong learning strategies that enhance individuals' ability to deal with dynamic labor markets. In this context, informal learning emerges as a driver for fostering adaptive skills and facilitating smooth transitions from higher education to employment. This study aims to contribute to this discussion by providing a preliminary validation of the informal student learning (ISL) scale and examining direct and indirect relationships of ISL with career adaptability (CA), future sustainable career (FSC) and employability prospects, drawing on the sustainable career model and social cognitive career theory.

Design/methodology/approach – A sample of 151 Italian university students was surveyed at two time points. Confirmatory factor analyses were conducted to assess the factorial structure of the ISL scale. Structural equation modeling (SEM) was employed to test the hypothesized direct and indirect relationships, using a parceling approach with reliability-corrected single-indicator latent variables.

Findings – The results supported the reliability and validity of the ISL scale in the Italian context. SEM analyses revealed that ISL was indirectly related to employability prospects through the sequential mediation of CA and FSC.

Originality/value – This study advances the literature on sustainable career ecosystems by revealing the significance of ISL for career-related variables. The findings provide actionable insights for career guidance practices and higher education policies, emphasizing the importance of fostering informal learning to equip students with the skills needed to deal with dynamic and uncertain career ecosystems.

Keywords Informal learning, Career adaptability, Career sustainability, Career prospects, University students, Employability

Paper type Research article

Introduction

In today's rapidly evolving labor market, ensuring that young people follow development paths that align with career sustainability principles has become a major concern for both individuals and societies (Donald and Mouratidou, 2022). In this context, the concept of sustainable career ecosystem (Donald *et al.*, 2024) provides a comprehensive perspective for understanding how multiple actors (e.g. employed and unemployed individuals, organizations, institutions, and career practitioners) contribute to fostering career sustainability. Within this framework, it is possible to recognize the necessity of viewing career development as a continuous process shaped by both education and work realities, emphasizing the interdependencies between educational institutions and labor market structures, which influence the individual shift from the role of student to that of worker. The transition from university to employment is not merely an individual process but rather the outcome of an interconnected system where learning experiences play a central role in preparing individuals for their future jobs. Thus, a sustainable career ecosystem highlights the importance of strengthening the connections between learning experiences within educational institutions and transitions dynamics into the labor market, ultimately facilitating more sustainable careers (Baruch *et al.*, 2023; Heslin *et al.*, 2020).



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Among the key factors influencing career sustainability, learning processes play a crucial role in equipping individuals with the skills needed to transition successfully from education to work (Drewery *et al.*, 2020; Heslin *et al.*, 2020; Hui *et al.*, 2021). Specifically, not only formal learning (i.e. acquired through structured educational programs, university curricula, and qualifications) but also informal learning (i.e. self-directed, experience-based learning occurring outside structured educational settings) contributes to personal and professional development (Manuti *et al.*, 2015; Marsick and Watkins, 1990). While formal education remains a core component of higher education institutions, it alone may not be sufficient to prepare students for sustainable career pathways. Informal learning has been increasingly recognized as a crucial mechanism for skill acquisition and career growth (Giancaspro and Manuti, 2021; Manuti *et al.*, 2015). Unlike formal learning, which follows predefined curricula, informal learning takes place through peer collaboration, feedback-seeking behaviors, trial-and-error, and self-reflection (Decius *et al.*, 2019; Marsick and Watkins, 1990).

However, while informal learning in the workplace has received substantial attention, less is known about how it unfolds during the years of education and how it relates to future career paths (Ali Abadi *et al.*, 2023; Decius *et al.*, 2024a, b; Dougherty and Lombardi, 2016). This gap is reflected in the scarcity of validated instruments for assessing Informal Student Learning (ISL) in academic contexts, particularly in the Italian language. One of the few available tools in the literature to measure ISL is the scale developed by Decius *et al.* (2024a, b) in English and German, based on the Octagon Model of Informal Workplace Learning (Decius *et al.*, 2019), which identifies eight core dimensions of informal learning. Although this model was originally developed for workplace settings, its structure is highly relevant for understanding how students informally acquire competencies during academic years (Decius *et al.*, 2024a, b). Adapting this model to higher education provides a more comprehensive perspective on how students prepare for their careers beyond formal coursework. In the Italian context, however, to the best of our knowledge, no validated instrument exists to measure ISL, despite the availability of Italian-language tools aimed at assessing aspects of formal learning (e.g. Valente *et al.*, 2022). This limitation hinders our possibilities to systematically assess how students develop competencies outside formal curricula and restricts the design of targeted interventions aimed at fostering informal learning in higher education as a means of preparing for sustainable careers. Moreover, despite growing recognition of the importance of informal learning for career sustainability (Heslin *et al.*, 2020), empirical studies have largely overlooked its role in shaping career-related variables among university students. This gap is particularly relevant given that higher education institutions are expected to equip students not only with domain-specific knowledge but also with broader competencies that support long-term career sustainability (Guichard, 2018; Santilli *et al.*, 2020).

To address these gaps, this study pursues two main objectives. First, it provides a preliminary validation of the ISL scale (Decius *et al.*, 2024a, b) in an Italian sample of university students, assessing its factorial structure and psychometric properties. Second, drawing on the Sustainable Career Model (De Vos *et al.*, 2020) and the Social Cognitive Career Theory (Lent *et al.*, 1994; Lent and Brown, 2013), this study examines how informal learning contributes to career-related resources and employability prospects among university students. In this vein, using a two-wave survey design, we examined the direct and indirect relationships of ISL (T1) with career adaptability (CA) (T1), future sustainable career (FSC) (T2), and Employability Prospects (T2). Specifically, we expect that ISL is positively related to CA, which in turn enhances students' perceptions of FSC, ultimately leading to better Employability Prospects (see Figure 1).

By introducing a validated measure of ISL in the Italian context and demonstrating its role for career-related variables, this study intends to advance the literature on sustainable careers and provide practical contributions for higher education institutions and students. From a theoretical perspective, we seek to offer empirical support for the role of informal learning in

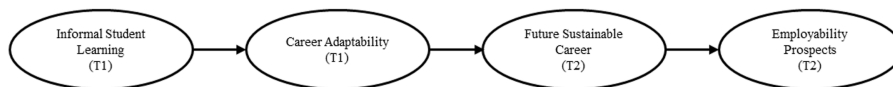


Figure 1. The research model. **Source(s):** Authors' own work

shaping future careers, further integrating learning dynamics into career sustainability research. On a practical level, the study aims to provide insights for career guidance practices and university policies, highlighting the importance of fostering informal learning to better equip students with the competencies needed to develop sustainable career paths.

Theoretical background

The measurement of informal learning

Informal learning has been conceptualized as a multidimensional process encompassing cognitive, behavioral, and motivational components through which individuals acquire knowledge and skills outside formal instructional settings (Marsick and Watkins, 1990; Manuti *et al.*, 2015). In higher education, informal learning complements formal instruction by enabling students to actively construct knowledge, develop transferable competencies, and make sense of academic and career-related challenges through experience, interaction, and reflection (Winter and Cotton, 2012). Building on this perspective, Decius *et al.* (2024a, b) adapted the Octagon Model of Informal Workplace Learning to academic contexts, proposing the ISL scale as a higher-order construct composed of multiple first-order dimensions that reflect different modes of informal learning among university students. Specifically, the ISL scale captures learning by trial and error (i.e. experimenting with one's own ideas and learning from direct feedback), learning from fellow students (i.e. model learning and vicarious feedback), reflective learning (i.e. anticipatory and subsequent reflection on learning experiences), and intent to learn (i.e. intrinsic and extrinsic motivation to engage in informal learning activities). Together, these dimensions represent complementary yet distinct processes through which students actively engage in informal learning during their academic careers.

From a measurement perspective, validating such a complex hierarchical structure requires empirical evidence that its factorial validity is adequately represented in the data, accounting for the relations between first-order dimensions, higher-order factors, and an overarching general construct. Establishing factorial validity is therefore essential to confirm that the theorized structure of ISL is empirically supported in the Italian context. In addition, convergent validity provides evidence that each ISL dimension captures a substantial proportion of variance in its indicators, supporting the assumption that the items meaningfully represent their intended latent constructs. Discriminant validity, in turn, is crucial to demonstrate that the different dimensions of ISL reflect related but non-redundant informal learning processes, rather than overlapping manifestations of a single undifferentiated construct (Fornell and Larcker, 1981). Importantly, in the present study, convergent and discriminant validity are examined primarily to assess the distinctiveness among the ISL dimensions themselves, rather than to differentiate ISL from external constructs. The criterion-related validity of ISL is subsequently examined through the hypothesized mediation model (see H2), which tests whether ISL is meaningfully related to theoretically relevant career-related outcomes.

These forms of measurement validity are particularly relevant when adapting an instrument to a new language and cultural context (Brown, 2015), as institutional practices and educational norms may influence how informal learning activities are perceived and enacted by students. Demonstrating factorial, convergent, and discriminant validity of the ISL scale in the Italian context is therefore a necessary step to ensure its psychometric adequacy and to enable meaningful empirical research on informal learning in higher education. Accordingly, the present study hypothesizes that:

- H1. The Italian version of the ISL scale has factorial (H1a), convergent (H1b), and discriminant (H1c) validity, consistent with the factorial structure of the original version.

Informal learning and career

The rationale for investigating the role of ISL in career-related variables is based on career theories that conceptualize careers as dynamic developmental processes influenced by learning experiences over time, particularly the Sustainable Career Model (De Vos *et al.*, 2020) and the Social Cognitive Career Theory (Lent *et al.*, 1994; Lent and Brown, 2013). The Sustainable Career Model (De Vos *et al.*, 2020) posits that careers unfold as long-term trajectories in which individuals continuously strive to maintain happiness, health, and productivity across changing work and life contexts. From this perspective, learning experiences represent a key process through which individuals develop personal resources that enable them to actively shape and sustain their careers over time. Informal learning, in particular, may play a crucial role in this process by fostering adaptability and self-regulatory resources that support the pursuit of sustainable career paths already during the early stages of career development, such as university education (De Vos *et al.*, 2016; Donald *et al.*, 2024; Heslin *et al.*, 2020).

Complementing this view, Social Cognitive Career Theory (Lent *et al.*, 1994; Lent and Brown, 2013) emphasizes the role of learning in shaping individuals' career-related cognitions, such as adaptive competencies, expectations about future outcomes, and perceived career opportunities. According to this theory, learning experiences contribute to career development by influencing how individuals interpret their capabilities and future possibilities, thereby guiding career-related choices and expectations. From this perspective, ISL can be conceptualized as a developmental context through which students acquire and refine career-relevant resources that inform both their capacity to manage career transitions and their Employability Prospects (Crans *et al.*, 2021; Decius *et al.*, 2024a, b; Houben *et al.*, 2021).

Among different career-related variables, we focused on CA, FSC, and Employability Prospects because these constructs capture key aspects of how students prepare for their career paths by developing adaptability in the present and fostering aspirations for sustainability and satisfactory job prospects in the future. Within the Sustainable Career Model and Social Cognitive Career Theory, these constructs represent key self-regulatory and future-oriented career mechanisms linking learning experiences to longer-term career outcomes. In line with this theoretical rationale, the temporal separation adopted in the present study reflects the developmental ordering implied by these frameworks. ISL and CA were measured at T1 because they represent proximal learning experiences and self-regulatory resources that are expected to develop in the present and to function as antecedents in the career development process. In contrast, FSC and Employability Prospects were assessed at T2, as they reflect more distal, future-oriented evaluations concerning long-term career sustainability and perceived opportunities in the labor market. This time-lagged design is consistent with career theories that conceptualize adaptability and learning-related resources as precursors shaping subsequent career-related expectations and evaluations, rather than immediate outcomes of such perceptions.

CA refers to an individual's ability to manage career-related challenges and transitions by developing personal resources such as concern, control, curiosity, and confidence (Savickas, 2005; Savickas and Porfeli, 2012). Given that ISL involves self-directed learning and problem-solving through real-world experiences, it is likely to strengthen students' resources to adapt to an uncertain labor market by enhancing learning-based self-efficacy, proactive career behaviors, and career-related agency. In this vein, previous studies found that engaging in active learning through challenging tasks and continuous skill updating enabled individuals to reflect on and refine their approaches to adapting their careers (e.g. Brown, 2015; Hui *et al.*, 2021). Considering the characteristics of CA, it may play a role in determining FSC. Within the

Sustainable Career Model, adaptability is considered a core personal resource supporting long-term career sustainability across changing contexts in response to changing demands and opportunities. FSC has been recently defined not only by an individual's sense of achievement and career fulfillment (happiness), physical and mental well-being (health), and ability to perform effectively (productivity) (De Vos *et al.*, 2020), but also by its broader impact on society contributing to positive social change and development (social empowerment) (Russo *et al.*, 2023). Therefore, the aspiration and future achievement of a sustainable career characterized by these dimensions can be directly supported by the personal resources to adapt in a dynamic career context and indirectly promoted by ISL which shapes CA. In this vein, previous research has found a positive relationship between CA and sustainability, showing that individuals with higher adaptability resources are better equipped to manage career transitions and uncertainties, fostering long-term career sustainability (e.g. Giancaspro *et al.*, 2023; Talluri *et al.*, 2022; Zyberaj *et al.*, 2022).

Furthermore, the concept of a FSC is closely related to Employability Prospects, which capture individuals' expectations regarding their possibilities of being employable in the future (Berntson and Marklund, 2007; Lo Presti and Nonnis, 2012; Waaijer, 2017). From a Social Cognitive Career Theory perspective (Lent *et al.*, 1994; Lent and Brown, 2013), Employability Prospects can be understood as positive outcome expectations that are grounded in individuals' self-appraisals of having the resources, competencies, and adaptive capacities needed to achieve desired career outcomes. Within this perspective, perceiving one's future career as sustainable may provide a broader evaluative framework that informs and strengthens satisfactory employment expectations. In other words, individuals who perceive their long-term career paths as sustainable may also have a stronger sense of security and optimism regarding their access to future job opportunities. This perception of employability can be indirectly promoted by ISL, which enables students to develop competencies that would be useful for career development and strengthen confidence in their career-related resources. Thus, positive Employability Prospects could be expected to emerge directly from perceptions of FSC and indirectly through a developmental path that starts with ISL, strengthens CA, and supports career sustainability. In this vein, previous studies have found that individuals who exhibit the characteristics of career sustainability tend to report a stronger belief in their capacity to secure a satisfactory job in terms of employability and job marketability (e.g. Blokker *et al.*, 2019; Lent *et al.*, 2024). Thus, considering the theoretical and empirical arguments outlined above, and drawing on career theories that emphasize the accumulation of resources and long-term sustainability, the present study hypothesizes that:

- H2. ISL (T1) is indirectly related to Employability Prospects (T2) through the sequential mediation of Career Adaptability (T1) and Future Sustainable Career (T2).

Method

Procedure and participants

Data were collected through an online survey administered to Italian university students using a convenience sampling method. The survey was distributed via student mailing lists, forums, and social media channels between October 2024 and February 2025. The study adhered to the principles outlined in the Helsinki Declaration and the General Data Protection Regulation (EU, 2016/679) and was approved by the ethics committee of the authors' institution. Participation was anonymous and voluntary, and all respondents provided informed consent before completing the questionnaire.

The study adopted a two-wave longitudinal design, with an interval of approximately three months between Time 1 (T1) and Time 2 (T2). To match responses across time points while maintaining anonymity, participants were asked to generate a pseudonymization code, which they entered at the beginning of both surveys.

Established recommendations on determining an adequate sample size were considered (Kyriazos, 2018) and an *a priori* power analysis was conducted to ensure sufficient statistical power. For factor analyses, guidelines suggest that the sample size (*N*) should exceed the number of measured variables (*p*), with recommended *N:p* ratios ranging from 5:1 to 10:1. For structural equation modeling (SEM), an *a priori* power analysis was conducted using *R* (R Core Team, 2024) and the *semPower* package (Moshagen and Bader, 2024): the calculation recommended a minimum sample size of 78 subjects, assuming an root mean square error of approximation (RMSEA) level of 0.08, a significance level of 0.05, a power of 0.90, and a model with 101 degrees of freedom (i.e. testing the hypothesized relationships with 16 observed variables and four latent variables). Based on these criteria and accounting for a 30% expected attrition rate between T1 and T2, we estimated that at least 120 participants at Time 1 were necessary to ensure sufficient statistical power.

For factor analyses on the ISL scale, our T1 dataset included 151 participants, which met the minimum requirements for factorial validation given the 24-item structure. For SEM analysis, 95 participants completed both time points, ensuring an adequate sample for testing our hypothesized relationships. The T1 sample consisted of 77% female and 23% male students, with age ranging from 19 to 32 (*M* = 21.53, standard deviation (*SD*) = 2.42). The paired T1-T2 sample consisted of 81% female and 18% male students, with age ranging from 19 to 32 (*M* = 20.66, *SD* = 2.02).

Measures

ISL (T1). This variable was measured using an Italian translation of the scale validated by Decius *et al.* (2024a, b) with samples of German and US universities. The translation process followed a back-translation procedure (Brislin, 1986) to ensure linguistic and conceptual equivalence. Specifically, the scale was first translated from English to Italian by a bilingual expert, and then back translated into English. Discrepancies between the original and back-translated versions were discussed and resolved by a panel of experts in work and organizational psychology. The Italian items are presented in Table 1 of the Results section.

The structure of the scale is based on the Octagon Model of Informal Workplace Learning (Decius *et al.*, 2019). The scale consists of 24 items, grouped into 8 dimensions, each comprising three items. These 8 dimensions are further categorized into four higher-order factors, reflecting distinct facets of informal learning. The eight dimensions are: Trying/Applying Own Ideas (learning through personal experimentation); Direct Feedback (actively seeking feedback from instructors or peers); Model Learning (observing and adopting strategies from peers); Vicarious Feedback (learning through feedback given to others); Anticipatory Reflection (reflecting before engaging in a task); Subsequent Reflection (evaluating one's learning process after completing a task); Extrinsic Intent to Learn (learning driven by external motivations, such as grades or recognition); and Intrinsic Intent to Learn (learning motivated by personal growth and interest). These dimensions are grouped into the following four higher-order factors: Learning by Trial and Error (Trying/Applying Own Ideas + Direct Feedback); Learning from Fellow Students (Model Learning + Vicarious Feedback); Reflection (Anticipatory Reflection + Subsequent Reflection); and Intent to Learn (Extrinsic Intent to Learn + Intrinsic Intent to Learn). All items were rated on a six-point Likert scale ranging from 1 (Not agree at all) to 6 (Fully agree). In the present sample, Cronbach's alpha was 0.88 for the total scale and ranged between 0.71 and 0.92 for the eight dimensions.

CA (T1). This variable was assessed using the Italian version (Soresi *et al.*, 2012) of the Career Adapt-Abilities Scale (Savickas and Porfeli, 2012), which measures individuals' resources for managing occupational transitions, developmental tasks, and work traumas. The scale consists of 24 items rated on a five-point Likert scale from 1 (Not strong) to 5 (Strongest). The items combine into an overall score of CA and are further categorized into four subscales with six items each: concern, control, curiosity, and confidence. Concern refers to awareness and planning for the future (e.g. "Thinking about what my future will be like"). Control refers

Table 1. Italian items of the informal student learning scale

Second-order dimension	First-order dimension	Italian item	Item factor loading
Learning by trial and error (0.97)	Trying/Applying Own Ideas (0.71)	Se ho difficoltà con lo studio, cerco un metodo alternativo	0.56
		Applico le mie idee alle attività di studio nuove	0.79
		Utilizzo le mie idee per trovare soluzioni alle attività di studio complesse	0.79
	Direct Feedback (0.47)	Cerco riscontri dai miei docenti su come svolgo le attività di studio	0.78
		Chiedo spiegazioni ai docenti se non sono sicuro della mia soluzione ad un problema	0.84
		I docenti mi aiutano a capire come posso migliorare il mio studio	0.54
Learning from fellow students (0.56)	Model Learning (0.74)	All'università osservo come altri studenti affrontano lo studio per migliorare il mio approccio	0.89
		Osservo come i miei colleghi svolgono le attività di studio per non commettere gli stessi errori	0.67
		Nei miei studi, provo metodi che ho imparato dai miei colleghi	0.68
	Vicarious Feedback (0.93)	Mi confronto con i colleghi sulle esperienze durante le attività di studio	0.80
		Chiedo ai miei colleghi quali metodi e trucchi utilizzano nei loro studi	0.88
		Chiedo ai miei colleghi suggerimenti e consigli per lo studio	0.85
Reflection (0.91)	Anticipatory Reflection (0.76)	Prima di affrontare un'attività di studio nuova, penso a come posso svolgerla al meglio	0.85
		Prima di iniziare un percorso di studio, penso a come prepararmi per affrontarlo	0.83
		Prima di una nuova attività di studio, penso a quali aspetti dovrei prestare particolare attenzione	0.85
	Subsequent Reflection (0.67)	Quando finisco un'attività di studio, rifletto su come ho lavorato	0.83
		Quando finisco un'attività di studio, penso a cosa potrei fare meglio la prossima volta	0.87
		Quando finisco un'attività di studio, rifletto in modo critico sulla soluzione che ho adottato	0.90
Intent to learn (0.80)	Extrinsic Intent to Learn (0.50)	Voglio imparare qualcosa da solo al di fuori dei corsi accademici, per migliorare rispetto ai miei colleghi	0.63
		Voglio imparare qualcosa da solo al di fuori dei corsi accademici, per dimostrare il mio valore ai docenti	0.69
		Voglio imparare qualcosa da solo al di fuori dei corsi accademici, per mostrare cosa sono in grado di fare durante i corsi	0.85
	Intrinsic Intent to Learn (0.72)	Voglio imparare qualcosa da solo al di fuori dei corsi accademici, per affrontare meglio le difficoltà e le sfide nei miei studi	0.91
		Voglio imparare qualcosa da solo al di fuori dei corsi accademici, per risolvere più rapidamente i problemi nei miei studi	0.80
		Voglio imparare qualcosa da solo al di fuori dei corsi accademici, per lavorare al meglio anche con compiti di studio difficili	0.89

Note(s): Standardized factor loadings refer to the confirmatory factor analysis (CFA) results and are all statistically significant at $p < 0.001$. Loadings reported in the main column refer to item loadings on their respective first-order latent dimensions. Loadings of first-order dimensions on their corresponding second-order factors are reported in parentheses, as well as loadings of second-order factors on the higher-order general ISL factor

Source(s): Authors' own work

to self-discipline and responsibility for career decisions (e.g. “Making decisions by myself”). Curiosity refers to exploration of career opportunities (e.g. “Investigating options before making a choice”). Confidence refers to belief in the own ability to overcome obstacles (e.g. “Performing tasks efficiently”). In the present study, Cronbach’s alphas were 0.84, 0.82, 0.81, and 0.89 for concern, control, curiosity, and confidence, respectively, and 0.93 for the total scale.

FSC (T2). This variable was measured using the FSC scale (Russo *et al.*, 2025), which consists of 16 items divided into those four dimensions, with four items per dimension. The scale was built upon Russo and colleagues’ model (2023), which conceptualizes a sustainable career as comprising happiness, health, productivity, and social empowerment. Happiness refers to an individual’s orientation to pursue a satisfying and meaningful career that aligns with their personal aspirations (e.g. “During my future career, I will feel fulfilled as a person”). Health refers to the extent to which one’s future career is perceived as supportive of physical and mental well-being (e.g. “My future career will not cause me anxiety”). Productivity refers to individual expectation of being competent in their career and performing effectively over time (e.g. “My future career will allow me to express my talents and abilities”). Social empowerment refers to the extent to which individuals perceive their careers as a way to create positive social impact (e.g. “I feel that with my future career I can contribute to improving the quality of life of society”). All items were rated on a five-point Likert scale, ranging from 1 (Strongly disagree) to 5 (Strongly agree), with higher scores indicating stronger perceptions of FSC. In the present study, Cronbach’s alphas were 0.81, 0.78, 0.76, and 0.93 for happiness, health, productivity, and social empowerment, respectively, and 0.90 for the total scale.

Employability Prospects (T2). This variable was measured using four items adapted from the Italian Employability scale (Lo Presti and Nonnis, 2012), which assesses an individual’s perception of the likelihood of finding an acceptable job. The original scale consists of five items, however, we excluded the item “How likely are you to find a better job than the one you right now have in your company?” since the sample in the present study comprised university students who were not employed in a company. Similarly, the remaining four items were adapted to capture students’ perceptions about their future job opportunities, removing references to current employment. For example, we modified the item “How likely are you to find an acceptable job outside your company?” by replacing “outside your company” with “in the future”. The items were rated on a five-point scale, ranging from 1 (No probability) to 5 (100% probability). In the present study, Cronbach’s alpha was 0.79.

Data analysis

All analyses were conducted using R (R Core Team, 2024). To validate the factorial structure of the ISL scale, we performed a series of confirmatory factor analyses (CFA) on the T1 sample ($N = 151$). The CFA were conducted to confirm the higher-order factor structure identified in the original validation study (Decius *et al.*, 2024a, b). Since the assumption of multivariate normality was not met with a Henze and Zirkler’s (1990) index of 1.02 ($p < 0.001$), we employed robust maximum likelihood estimation (MLR). Model fit was assessed using multiple fit indices: Chi-square statistic (χ^2), comparative fit index (CFI) and Tucker–Lewis Index (TLI), RMSEA and standardized root mean square residual (SRMR). To further confirm the factorial validity of the scale, we compared the fit of the four-factor structure against alternative measurement models. Model comparisons were conducted using the chi-square difference test ($\Delta\chi^2$). Since we employed robust MLR, we applied the Satorra and Bentler (2010) correction to account for non-normality in the data. Convergent and discriminant validity were assessed through the examination of average variance extracted (AVE) and shared variance (i.e. squared correlation) (Fornell and Larcker, 1981). Specifically, we adopted the Fornell–Larcker criterion for discriminant validity to evaluate whether each dimension’s AVE value was higher than the shared variance (i.e. squared correlation) with different dimensions.

To test the hypothesized relationships between ISL, CA, FSC, and Employability Prospects, we performed SEM analyses on the paired T1-T2 sample ($N = 95$). Indirect effects

were examined using bootstrapping with 5,000 resamples, generating 95% confidence intervals to determine their significance. Given the relatively small size of the paired sample, we reduced the factor loadings by employing a parceling approach for a reasonable ratio between the number of parameters to estimate and the sample size (Landis *et al.*, 2000). Consequently, each first-order latent dimension was measured by a single observed parcel, created by averaging the items within that dimension. Following best practices for higher-order structural models composed of latent variables with a single indicator, we adopted a reliability-corrected single-indicator approach. Specifically, we applied a correction for measurement error by fixing the residual variance of each parcel to $(1 - \text{reliability})$ multiplied by the variance of the observed parcel score (Bollen, 1989; Cheung *et al.*, 2021). Cronbach's alpha was used as an estimate of reliability to ensure that the latent construct variance appropriately accounted for measurement error.

Results

Italian version of the informal student learning (ISL) scale

To test Hypothesis 1 regarding the validity of the Italian version of the ISL scale, a series of CFA were conducted using the T1 sample ($N = 151$). The CFA models were tested to assess the factorial (H1a), convergent (H1b), and discriminant (H1c) validity of the instrument. First, we tested the factorial structure of the original scale (1-4-2 structure), in which the 24 items served as indicators of their respective eight first-order latent factors, which in turn were paired to form four second-order latent factors, ultimately measuring the higher-order latent construct of informal learning. Details on the dimensions and their labels are provided in the Measures section. This measurement model showed satisfactory fit indices (χ^2 (240) = 372.21, $p < 0.001$, CFI = 0.93, TLI = 0.92, RMSEA = 0.06, SRMR = 0.08) and significant standardized factor loadings ranging from 0.54 to 0.91 as shown in Table 1, thus confirming H1a and supporting the factorial validity of the Italian version of the scale.

Subsequently, alternative measurement models were tested, as shown in Table 2. Specifically, we examined a single-factor model, which exhibited poor fit to the data (χ^2 (252) = 1386.29, $p < 0.001$, CFI = 0.39, TLI = 0.33, RMSEA = 0.17, SRMR = 0.14), suggesting that a single underlying factor was insufficient to explain the covariances among the indicators. Next, we tested additional theoretically plausible measurement models (Decius *et al.*, 2024a, b) that maintained the grouping of the eight first-order latent variables while

Table 2. Alternative measurement models of the informal student learning scale

Model	χ^2	df	p	CFI	TLI	RMSEA	SRMR	ΔCFI	$\Delta\chi^2$ (df)
1-4-2 structure	372,219	240	<0.001	0.930	0.919	0.060	0.080	–	–
1-0-8 structure	414,541	244	<0.001	0.909	0.897	0.068	0.091	0.021	20.538 (4)***
0-4-2 structure	365,843	238	<0.001	0.932	0.921	0.060	0.076	0.002	4.020 (2)
0-0-8 structure	319,342	224	<0.001	0.949	0.937	0.053	0.059	0.018	40.629 (16)***

Note(s): 1-4-2 structure = 24 items served as indicators of their respective eight first-order latent factors, which in turn were paired to form four second-order latent factors, ultimately measuring an higher-order latent construct; 1-0-8 structure = a general factor directly encompassed the eight components, without an intermediate level; 0-4-2 structure = the eight components were paired under four higher-order latent variables, but without an overarching general factor; 0-0-8 structure = each of the eight first-order latent variables correlated with the others, without any higher-order factor. $\Delta\chi^2$ and ΔCFI indicate differences with respect to the baseline measurement model with a 1-4-2 structure; differences are reported as absolute values. *** $p < 0.001$

Source(s): Authors' own work

varying the composition of the higher-order levels: 1-0-8 structure, in which a core informal learning factor directly encompassed the eight components, without an intermediate level (χ^2 (244) = 414.54, $p < 0.001$, CFI = 0.91, TLI = 0.90, RMSEA = 0.07, SRMR = 0.09); 0-4-2 structure, in which the eight components were paired under four higher-order latent variables, but without an overarching general factor (χ^2 (238) = 365.84, $p < 0.001$, CFI = 0.93, TLI = 0.92, RMSEA = 0.06, SRMR = 0.08); 0-0-8 structure, in which each of the eight first-order latent variables correlated with the others, without any higher-order factor (χ^2 (224) = 319.34, $p < 0.001$, CFI = 0.95, TLI = 0.94, RMSEA = 0.05, SRMR = 0.06).

These theoretically plausible measurement models demonstrated satisfactory fit indices. Therefore, we compared each of these alternative structures with the original 1-4-2 structure using a chi-square difference test with the Satorra-Bentler correction. The results indicated that the 1-4-2 structure was statistically superior to the 1-0-8 structure ($\Delta\chi^2$ (4) = 20.54, $p < 0.001$) and did not differ significantly from the 0-4-2 structure ($\Delta\chi^2$ (2) = 4.02, $p > 0.05$), but showed a significant difference compared to the 0-0-8 structure ($\Delta\chi^2$ (16) = 40.63, $p < 0.001$) which would be preferable based on fit indices. Despite this latter result, the 1-4-2 structure remains more parsimonious than the 0-0-8 structure, while still meeting acceptable fit thresholds and maintaining theoretical consistency with the original validation study (Decius *et al.*, 2024a, b). Consequently, we opted to retain the 1-4-2 structure, which can be considered adequate and particularly useful for examining the relationships between a general construct of informal learning and external variables.

To assess the convergent and discriminant validity of the different dimensions of ISL, we considered the AVE and the shared variance (i.e. squared correlation) among dimensions. The AVE values for all first-order dimensions ranged between 0.51 and 0.75, supporting convergent validity (H1b). The shared variance between different dimensions ranged from 0.01 to 0.47, with the highest value observed between the factor “Model Learning” (AVE = 0.59) and the factor “Vicarious Feedback” (AVE = 0.72). Thus, discriminant validity was supported (H1c), as the Fornell–Larcker criterion was met with all AVE values exceeding the corresponding shared variance values.

Relationships between ISL and career-related variables

Before testing the hypothesized relationships in Hypothesis 2, we examined the correlations among the study variables and their subdimensions using the paired T1-T2 sample ($N = 95$). The results are reported in Table 3, together with the means, standard deviations, and Cronbach’s alpha coefficients for each scale.

To test Hypothesis 2, we fitted the model shown in Figure 2 using the paired T1-T2 sample ($N = 95$) to examine the indirect effect of ISL (T1) on Employability Prospects (T2) via CA (T1) and FSC (T2). In this model, the constructs of interest were treated as second-order latent variables, each measured by its respective first-order dimensions (as detailed in the Measures section), except for Employability Prospects which is a unidimensional construct and was modeled as a first-order latent variable. Considering the relatively small sample size, we created item parcels by averaging the item scores within each dimension to enhance model stability (Landis *et al.*, 2000). This approach was applied only to constructs measured through multiple dimensions, whereas Employability Prospects was directly measured by using its items. Specifically, ISL, CA, and FSC were modeled as second-order latent variables, each defined by four first-order dimensions, which were measured using single observed indicators (i.e. parcels). The parcels were treated as indicators of the corresponding reliability-corrected single-indicator latent dimensions, fixing the residual variance of each parcel to (1 – reliability) multiplied by the variance of the observed parcel score (Bollen, 1989; Cheung *et al.*, 2021). Before testing the hypothesized relationships, we conducted a CFA on this measurement model with the four constructs of interest, which confirmed a satisfactory goodness-of-fit (χ^2 (98) = 138.86, $p < 0.05$, CFI = 0.93, TLI = 0.91, RMSEA = 0.06, SRMR = 0.07).

Table 3. Means, standard deviations, correlations and Cronbach's alphas

	M	SD	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1. Informal student learning (ISL)	4.04	0.60	(0.88)																			
2. ISL-trying/ applying own ideas	4.25	0.76	0.57***	(0.71)																		
3. ISL-direct feedback	3.59	1.04	0.60***	0.23*	(0.80)																	
4. ISL-model learning	2.64	1.11	0.54***	0.11	0.26*	(0.75)																
5. ISL-vicarious feedback	4.18	1.06	0.58***	0.17	0.60***	0.27**	(0.85)															
6. ISL-anticipatory reflection	4.72	0.85	0.61***	0.39***	0.08	0.20	0.23*	(0.88)														
7. ISL-Subsequent reflection	4.79	0.98	0.65***	0.40***	0.18	0.23*	0.26*	0.50***	(0.92)													
8. ISL-extrinsic intent to learn	3.37	1.26	0.56***	0.21*	0.25*	0.21*	0.11	0.16	0.23*	(0.82)												
9. ISL-intrinsic intent to learn	4.78	1.02	0.66***	0.46***	0.18	0.18	0.12	0.55***	0.43***	0.31**	(0.89)											
10. Career adaptability (CA)	4.09	0.52	0.43***	0.59***	0.03	0.13	0.04	0.39***	0.27**	0.25*	0.47***	(0.93)										
11. CA-concern	4.11	0.61	0.24*	0.43***	-0.03	0.03	-0.05	0.33***	0.24*	0.05	0.31**	0.80***	(0.84)									
12. CA-control	4.11	0.62	0.30**	0.47***	-0.04	0.08	0.08	0.29**	0.15	0.17	0.35***	0.87***	0.62***	(0.82)								
13. CA-curiosity	4.13	0.57	0.52***	0.56***	0.20*	0.23*	0.07	0.36***	0.34***	0.32**	0.47***	0.79***	0.46***	0.55***	(0.81)							
14. CA-confidence	4.02	0.67	0.40***	0.53***	-0.01	0.11	0.03	0.34***	0.21*	0.30**	0.47***	0.91***	0.61***	0.76***	0.70***	(0.89)						
15. Future sustainable career (FSC)	3.91	0.47	0.24*	0.42***	0.03	0.04	0.01	0.30**	0.21*	-0.02	0.31**	0.52***	0.45***	0.45***	0.38***	0.47***	(0.90)					
16. FSC-happiness	4.14	0.54	0.23*	0.39***	0.12	-0.01	-0.05	0.31**	0.18	0.09	0.18	0.43***	0.41***	0.38***	0.29**	0.38***	0.80***	(0.81)				
17. FSC-productivity	4.03	0.54	0.27**	0.46***	-0.04	0.12	0.02	0.25*	0.20	0.10	0.30**	0.58***	0.46***	0.55***	0.41***	0.53***	0.79***	0.59***	(0.76)			
18. FSC-health	3.33	0.63	0.06	0.18	0.02	-0.04	0.03	0.16	0.11	-0.18	0.10	0.36***	0.37***	0.27**	0.27**	0.31**	0.70***	0.41***	0.38***	(0.78)		
19. FSC-social empowerment	4.13	0.73	0.20*	0.30**	0.00	0.05	0.02	0.23*	0.17	-0.04	0.35***	0.28**	0.20	0.24*	0.23*	0.26**	0.81***	0.53***	0.53***	0.37***	(0.93)	
20. Employability prospects	3.49	0.59	0.14	0.19	0.01	0.12	-0.12	0.19	0.09	0.06	0.17	0.19	0.14	0.18	0.14	0.18	0.47***	0.49***	0.32**	0.26*	0.39***	(0.79)

Note(s): $n = 95$. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. M = mean; SD = standard deviation. Cronbach's alphas are reported on the diagonal within parentheses

Source(s): Authors' own work

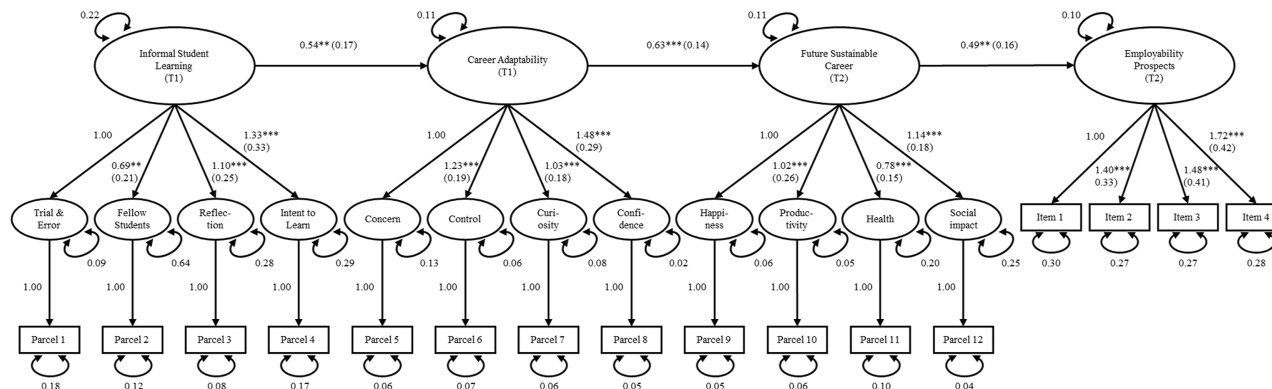


Figure 2. Parameter estimates for the latent mediation model. **Note(s):** *** $p < 0.001$, ** $p < 0.01$. Coefficients are unstandardized. Standard errors are reported in parentheses. The residual variance of each parcel was fixed to $(1 - \text{reliability})$ multiplied by the variance of the observed parcel score. **Source(s):** Authors' own work

Then, we tested the SEM model including the indirect effect of ISL (T1) on Employability Prospects (T2) through the sequential mediation of CA (T1) and FSC (T2). The model demonstrated a good fit to the data ($\chi^2(101) = 141.56, p < 0.05, CFI = 0.93, TLI = 0.91, RMSEA = 0.06, SRMR = 0.08$). Figure 2 displays the unstandardized parameter estimates for the bivariate relationships involved. The results showed that ISL was positively related to CA ($B = 0.54, \text{standard error (SE)} = 0.17, p < 0.01, \beta = 0.61$), and CA was positively related to FSC ($B = 0.63, SE = 0.14, p < 0.001, \beta = 0.62$). In turn, FSC was positively related to Employability Prospects ($B = 0.49, SE = 0.16, p < 0.01, \beta = 0.55$). The indirect effect of ISL on Employability Prospects via CA and FSC was positive ($B = 0.17, SE = 0.08, \beta = 0.21$) and statistically significant (95% CI = [0.05, 0.36]), thus supporting Hypothesis 2. We also examined the indirect effect of ISL on FSC via CA, which was positive ($B = 0.34, SE = 0.11, \beta = 0.38$) and statistically significant (95% CI = [0.13, 0.61]). Additionally, we computed the completely standardized indirect effects to have an effect size measure of those relationships, showing a standardized value of 0.21 for the indirect effect on Employability Prospects and a standardized value of 0.38 for the indirect effect on FSC. The model explained 38% of the variance in CA, 38% in FSC, and 30% in Employability Prospects.

Discussion and conclusions

This study aimed to investigate the role of informal learning in shaping career-related variables in a sample of university students. Specifically, we hypothesized the validity of the ISL scale (Decius *et al.*, 2024a, b) in the Italian context and tested a sequential mediation model in which ISL was indirectly related to Employability Prospects through CA and FSC. Results supported the validity of the scale and the proposed model of relationships. A series of CFA on the T1 sample ($N = 151$) demonstrated the factorial, convergent, and discriminant validity of the Italian version of the ISL scale with a complex structure consistent with the original scale (Decius *et al.*, 2024a, b), supporting Hypothesis 1. The structure involved 24 items grouped into eight first-order dimensions, which in turn were coupled into four second-order factors, which ultimately measured a higher-order general factor of informal learning. Then, SEM analyses conducted on the paired T1-T2 sample ($N = 95$) showed that ISL (T1) was indirectly and positively associated with Employability Prospects (T2) through the sequential mediation of CA (T1) and FSC (T2), supporting Hypothesis 2.

Considering the existing literature, these findings could provide some theoretical implications. Our study contributes to the literature by validating the ISL scale (Decius *et al.*, 2024a, b) in the Italian context. Building on the Octagon Model of Informal Workplace Learning (Decius *et al.*, 2019), our findings confirmed the factorial structure of the Italian version, demonstrating the applicability of the instrument beyond the original validation contexts. This validation is crucial for advancing research on informal learning in academic educational systems, particularly in languages and contexts where such measures are lacking. By providing a psychometrically reliable and valid instrument, our study facilitates further investigations into the role of informal learning in students' career development.

In this regard, the availability of a validated instrument to assess informal learning in higher education is particularly relevant, given that most research on this topic has traditionally focused on workplace contexts (e.g. Marsick and Watkins, 1990; Manuti *et al.*, 2015; Decius *et al.*, 2019). Although university and work settings differ in important ways, they also share several features of informal learning processes. In both contexts, individuals are required to construct knowledge through experience, make use of feedback, and engage in reflective learning. These shared characteristics help explain why the Octagon Model of Informal Learning (Decius *et al.*, 2019), originally developed for workplace, showed a good applicability in the university context (Decius *et al.*, 2024a, b). At the same time, educational contexts also present unique features, such as a stronger emphasis on self-directed study, peer exchanges, and preparatory career exploration. In this way, future research could also examine the applicability of alternative theoretical models of informal learning within educational

settings, potentially extending existing approaches. For example, an alternative perspective rooted in field-based learning is offered by the Self-regulated Informal Learning Cycle (Decius *et al.*, 2025), which may provide additional insights for academic contexts. This model explicitly integrates motivational, behavioral, and metacognitive components of informal learning, which are particularly relevant for higher education where students are required to actively regulate their learning motivation, reflect metacognitively on feedback and experiences, and align their learning behaviors with academic and career goals.

Moreover, our findings extend existing research on sustainable career ecosystems (Donald *et al.*, 2024) by highlighting the relevance of informal learning in shaping career-related variables for university students. Our results suggest that informal learning experiences undertaken during university years can contribute to students' CA and Future Career Sustainability, ultimately influencing their perceptions of finding a job. This evidence reinforces the idea that career development is a lifelong process that starts before entering the labor market and is shaped by learning experiences beyond formal education (De Vos *et al.*, 2016; Savickas, 2005). This is in line with our theoretical rationale based on the Sustainable Career Model (De Vos *et al.*, 2020) and the Social Cognitive Career Theory (Lent *et al.*, 1994; Lent and Brown, 2013), supporting the view that learning experiences accumulated during education constitute early resources that influence how individuals construct, adapt, and anticipate their future careers. Our results are consistent with previous research which demonstrated positive relationships between learning dynamics and career-related variables (e.g. Decius *et al.*, 2024a, b; Drewery *et al.*, 2020; Heslin *et al.*, 2020; Hui *et al.*, 2021; Nimmi *et al.*, 2024).

Specifically, informal learning can act as a driving force for university students in building future prospects of a sustainable career that goes beyond merely securing employment. A sustainable career reflects the extent to which individuals perceive their future career paths as valuable and fulfilling overtime in terms of happiness, health, productivity, and social empowerment (Russo *et al.*, 2023). Our findings highlight the role of informal learning in fostering a FSC encompassing all these aspects for university students. While securing a job remains a key objective—one that students will achieve through their personal and professional development—informal learning also fosters career-related competencies that empower students to aspire to career paths that are not only stable but also fulfilling, growth-oriented, and socially impactful. This suggests that beyond preparing students for immediate employment, informal learning plays a crucial role in shaping long-term career sustainability by equipping them with adaptability and a broader vision of their professional contributions.

In this vein, the identification of CA as a key mediating mechanism provides further insight into how informal learning translates into future career-related outcomes. The sequential mediation model suggests that ISL fosters CA, which in turn promotes perceptions of Future Sustainable Careers and Employability Prospects. This aligns with career construction theory (Savickas, 2005), which posits that adaptability serves as a critical self-regulatory resource in managing present and future career challenges, dealing with job transitions, and overcoming job-related difficulties. Our study extends this perspective by demonstrating how adaptability mediates the relationship between learning experiences and career outcomes, suggesting that simply engaging in informal learning is not enough to develop a sustainable career. Instead, students must actively translate informal learning experiences into adaptability resources to aspire to and perceive their future careers as sustainable (Hui *et al.*, 2021; Talluri *et al.*, 2022; Zyberaj *et al.*, 2022).

Taken together, our findings encourage future research to build a stronger theoretical bridge between learning research and career research. In this regard, future studies may benefit from the validation of the ISL instrument introduced in the present work and from considering informal learning experiences during higher education as an early mechanism through which career-related resources are developed. This perspective opens up avenues for more systematically integrating informal learning into career theories and models, for instance by

examining how informal learning processes interact with different career stages, thereby strengthening the dialog between informal learning research and sustainable career research.

From a practical perspective, our findings have some implications for higher education institutions and career counselors seeking to enhance sustainability of students' future careers. The validation of the ISL scale in the Italian context provides universities and researchers with a reliable tool to assess students' informal learning experiences systematically. This enables institutions to identify areas where students may need additional support and design targeted interventions to foster career-relevant learning outside formal curricula. For example, universities could implement mentorship programs, extracurricular projects, and peer-learning initiatives that encourage students to engage in collaborative and self-directed learning experiences. At the same time, the use of the ISL scale for comparative or individual diagnostic purposes should be approached with caution. In the absence of normative benchmarks, the scale is currently more appropriate for research purposes rather than for direct comparison across students or institutions. Nevertheless, the assessment of informal learning can still be informative for learning and career practices. For instance, the ISL scale may serve as a reflective tool within career counseling or guidance contexts, providing a starting point for discussion about students' learning experiences and preferred ways of learning. Such reflection can be further explored during counseling interviews to help students recognize how their informal learning practices contribute to the development of career-related resources and to identify areas for further growth.

Furthermore, given the critical role of informal learning in shaping career-related outcomes, higher education institutions should integrate strategies that explicitly promote these aspects. Career services and academic programs could incorporate reflective exercises, experiential learning, and career development workshops to help students recognize and articulate the value of their informal learning experiences. Our findings underscore the need for career guidance initiatives that emphasize broader future career sustainability. Universities and career advisors should encourage students not only to pursue stable employment but also to cultivate career paths that align with their well-being, growth, and societal contributions. Overall, these insights reinforce the need for a holistic approach to career education that recognizes informal learning as a crucial component of sustainable career development and actively supports students in translating their learning experiences into long-term career sustainability and job prospects (Guichard, 2018; Koen *et al.*, 2012; Santilli *et al.*, 2020).

On the other hand, this study has limitations that should be addressed in future research. The study was conducted with Italian university students and it exclusively used self-report questionnaires, which may limit its generalizability and introduce response bias. Future research should test the ISL scale in different cultural and educational contexts, including behavioral assessments of learning or multi-source data. A major limitation concerns the longitudinal design. Although the study adopted a two-wave design, the proposed sequential mediation model includes four constructs which would require four measurement points. Moreover, not all constructs were measured at all-time points, preventing the inclusion of autoregressive paths and limiting the possibility of isolating the unique longitudinal effects of ISL while controlling for baseline levels of the career-related variables. Therefore, the temporal ordering adopted in this study follows theoretical assumptions and should be interpreted with caution, as it does not provide evidence of strict causality. Relatedly, the three-month time lag between measurement points was not derived from an optimal lag estimation. In this vein, developmental changes, external events, or changes in respondents' circumstances occurring between T1 and T2 may have influenced the observed relationships. Although attrition occurred between T1 and T2, a more detailed dropout analysis would be desirable to examine whether attrition was selective with respect to demographic characteristics or study variables. Future studies should explicitly test different time intervals to better capture the developmental dynamics linking informal learning and career-related outcomes.

Moreover, future research could focus on more specific subgroups of university students to capture potential differences in informal learning processes and career development. For

example, students involved in internships may experience informal learning in ways that more closely resemble workplace contexts, with stronger implications for CA and employability. Similarly, examining differences across age groups or study phases (e.g. younger undergraduate students versus older students with prior work experience) could help clarify how the role of informal learning varies across stages of educational and career development.

Another important limitation concerns the sample size, which is relatively small for SEM, particularly when testing sequential mediation effects. Although the model converged and showed acceptable fit indices, small samples may lead to unstable parameter estimates, reduced statistical power to detect indirect effects, and biased standard errors. In addition, the use of a parceling approach, while justified to reduce model complexity and measurement error, may hide variability at the item level. Accordingly, the results should be interpreted cautiously. An alternative to parceling would have been the use of factor scores, which explicitly account for differences in item loadings and may preserve more information at the item level. However, factor scores also present limitations, as they are estimated with error and, when treated as observed variables, do not allow this error to be explicitly modeled in subsequent structural analyses, potentially introducing bias in parameter estimates. Compared to factor scores, parceling allowed us to reduce model complexity and improve model convergence in the present study, although both approaches involve methodological trade-offs that should be carefully weighed in future research. Replication studies with larger samples are needed and they could test the proposed model using item-level indicators or alternative modeling strategies.

Finally, the proposed model focuses on informal learning and CA as key mechanisms shaping Future Sustainable Careers and Employability Prospects. However, career development is influenced by a wide range of individual, contextual, and structural factors (e.g. labor market conditions, socioeconomic background, institutional support, personality traits) that were not included in the present model. Therefore, the model may be over-specified with respect to the role of ISL, and future research should examine more comprehensive models that integrate additional predictors and contextual variables.

Despite its limitations, and in light of its theoretical and practical implications, this study underscores the crucial role of informal learning in shaping sustainable career paths and highlights the need to integrate it more systematically into higher education and career development initiatives.

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