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RESEARCH ARTICLE

Assessing the socio-environmental impacts of technology-aided employment programs on graduate employability: A social psychological framework for action planning

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ABSTRACT

Despite growing scholarly interest in graduate employability, existing research has largely focused either on individual-level psychological attributes or macro-structural environmental conditions in isolation, leaving the dynamic interaction between personal psychological resources and socio-environmental contexts — particularly in the context of technology-mediated career development — underexplored. To address this gap, this study draws on Person-Environment Interaction Theory and Environmental Social Psychology as its theoretical framework, integrating three core constructs: individual psychological capital (encompassing self-efficacy, resilience, and career cognition), environmental support systems (comprising policy environment, technological infrastructure, and social support networks), and technology-assisted employment program engagement. A qualitative research design grounded in systematic open-source data integration was employed, combining thematic synthesis of publicly available graduate employment datasets, policy documents, and peer-reviewed empirical literature to capture both the breadth and depth of the phenomena under investigation. Findings reveal a structural imbalance in graduate employability, with social and human capital emerging as the primary developmental shortfall. Technology-assisted programs demonstrated meaningful positive patterns across employability dimensions, with impact varying by program type and usage context. The synthesized multi-level analytical framework further confirmed that employability formation is shaped by the interplay of individual and environmental factors, with psychological capital and policy support emerging as particularly influential. This study contributes to the field by offering an empirically grounded, integrative framework that advances employability theory beyond single-level explanations, while providing actionable evidence for the design of differentiated intervention strategies, the optimization of employment support policies, and the development of more contextually responsive technology-assisted career programs.

Keywords: technology-assisted employment programs; environmental social psychology; employability; multi-level framework; individual-environment interaction; college graduates

1. Introduction

Global economic structures are undergoing profound adjustments. Digital technology penetrates society at an accelerating pace. Against this backdrop, college graduate employment has evolved beyond simple labor

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market supply-demand contradictions. It now involves individual psychological adaptation. It encompasses social environment support. It includes technology empowerment. These elements form a complex systematic issue. Currently, China's college graduate numbers continue expanding. Structural employment contradictions become increasingly prominent. Traditional employment service models face transformation pressure. Technology-assisted employment programs have emerged as innovative practical pathways. However, their actual effects need systematic evaluation. Their operating mechanisms require deeper investigation [1]. International research demonstrates that graduate employment outcomes result from multiple intertwined factors. A study on Iranian public university graduates revealed dynamic feedback relationships between government policies and employment systems [2]. Research tracking Romanian graduates during and after the 2007–2008 financial crisis confirmed profound impacts of macroeconomic environments on employment results [3]. Geographic distribution tracking of American graduates emphasized how regional environmental differences shape employment choices [4]. These cross-cultural empirical evidences point to one core recognition: graduate employability formation and performance is not isolated individual behavior. Rather, it represents a social psychological process embedded in specific environmental contexts. Building on this theoretical lens, the present study operationalizes three core constructs central to Environmental Social Psychology. Environmental appraisal refers to graduates' cognitive evaluation of their surrounding employment context, encompassing assessments of policy stability, economic opportunity, and competitive intensity. Perceived affordances describe the extent to which graduates perceive available technological tools and social resources as actionable and beneficial to their career development. The stress-adaptation mechanism captures the dynamic process through which individuals mobilize psychological capital — including self-efficacy, resilience, and optimistic orientation — to cope with environmental pressures and sustain employability growth. These constructs function as interdependent components of a coherent person-environment transaction process rather than isolated variables. Accordingly, this study explicitly advances three research questions: (1) How do environmental factors independently and interactively shape graduate employability as documented in existing empirical literature? (2) Through what psychological pathways does psychological capital influence employability, as evidenced by published scholarship on career cognition and learning ability? (3) To what extent does person-environment fit moderate the effectiveness of technology-assisted employment programs, as synthesized from cross-contextual open-source evidence? We propose that employability represents a dynamically negotiated outcome shaped by the interplay between individual psychological resources and socio-technological affordances. From the theoretical lens of environmental social psychology, individual employability development and realization results from continuous interaction between personal psychological resources and environmental support systems. This includes macroeconomic policy environments and technological infrastructure at the macro level. It covers social support networks and organizational climate at the meso level. It also involves individual cognitive appraisal of environmental pressure and psychological adaptation mechanisms [5]. Existing research has noted differentiated impacts of various higher education institutions on graduate employment outcomes. Studies have explored connections between humanities and arts graduates' employability and social participation. Yet most research focuses on internal educational system factors or specific disciplinary fields. They lack in-depth discussion of dynamic interaction mechanisms among individual psychology, environmental contexts, and technological tools in employability formation [6]. Technology-assisted employment programs are becoming increasingly prevalent. How do environmental factors moderate technology use from a social psychological perspective? How does this usage influence individual psychological states and employability in return? These questions represent urgent theoretical and practical issues that need answers. Research on how equity practices within universities promote female graduate employability development suggests that micro-level institutional environment design significantly impacts specific group employment outcomes. This further highlights the necessity of incorporating environmental factors into employability research frameworks [7]. Facing the severe employment situation of

college graduates, the Chinese government has explicitly proposed caring for youth groups. It emphasizes strengthened bottom-line assistance. It calls for collective efforts to promote graduate employment. However, effective policy formulation requires scientific understanding of employability influence mechanisms [8]. Technology-assisted employment programs represent emerging intervention approaches. They include online career assessments, intelligent resume matching, virtual interview training, and professional social platforms. Theoretically, they can reduce information asymmetry, expand social networks, and enhance job-seeking skills. In practice, their effectiveness shows significant individual differences and contextual dependencies. Such variation may stem from individual factors like users' technology acceptance, digital literacy, and psychological readiness. It may also be constrained by environmental factors such as technology accessibility, social support quality, and policy environment friendliness. Existing research often treats technological tools as neutral external interventions. It overlooks that technology use itself constitutes a social psychological process. The realization of its effects depends on the match between individual psychological characteristics and environmental conditions. Therefore, we need to systematically examine the operating mechanisms of technology-assisted employment programs in real environmental contexts. This examination should adopt an integrated perspective from environmental social psychology. It should identify key individual and environmental factors affecting program effectiveness. The goal is providing evidence for optimizing program design and policy support systems. Based on these theoretical and practical needs, this study aims to construct a multi-level analytical framework through systematic synthesis of open-source empirical evidence. The framework integrates individual psychology, environmental contexts, and technological tools. It systematically evaluates technology-assisted employment programs' documented impacts on college graduate employability and their operating mechanisms. The theoretical innovation lies in introducing person-environment interaction theory from environmental social psychology into employability research, enriching and expanding the theoretical connotation of employability. The practical value lies in providing targeted suggestions for government departments to optimize employment policies, for universities to improve employment services, and for technology enterprises to refine product designs. Ultimately, this promotes higher quality and fuller employment goals for college graduates.

2. Literature review

Employability serves as the core link connecting higher education with labor markets. Its connotation and measurement show multi-dimensional evolutionary trends at both theoretical and practical levels. Traditional employability research focused on static assessment of individual knowledge, skills, and attitudes. The digital economy and technological change have brought profound impacts. Employability components and evaluation standards are undergoing deep reconstruction. Research using LSTM neural networks to predict college graduate employment situations shows that employment outcomes are influenced by complex interactions of multiple dynamic factors, and traditional linear models struggle to capture these changing patterns [9]. Analysis of local university students' employability revealed structural misalignment between capability cultivation and market demands, suggesting that employability enhancement requires systematic strategy design [10]. A study on tourism management graduates' employment intentions used the AHP-DEMATEL model, identifying a network of key factors influencing employment decisions, and emphasizing multi-factor interaction mechanisms in individual intention formation [11]. Entrepreneurial capability cultivation research found that experiential entrepreneurship education significantly impacts business graduates' entrepreneurial abilities and employment status, confirming the shaping effect of educational interventions on employability [12]. Application of probabilistic linguistic MAGDM methods in employment quality evaluation provided new technical pathways for multi-dimensional employability measurement [13]. These studies collectively indicate that employability is no longer a single individual attribute. It involves a comprehensive system with multiple dimensions, including cognitive abilities, social-emotional

competencies, digital skills, and entrepreneurial spirit. Its development and assessment need to adapt to labor market dynamics and technological progress. However, existing research mostly examines employability unidirectionally. Some studies focus on the educational supply side; others on the labor demand side. Integrated analysis of individual psychological mechanisms, environmental contextual factors, and technological tool effects remains insufficient. Research particularly lacks systematic exploration of person-environment interaction mechanisms in employability formation from an environmental social psychology perspective. Environmental factors' influence on graduate employability and employment outcomes increasingly attracts academic attention. Yet existing research mostly focuses on structural factors such as macroeconomic environments, policy environments, or educational systems, while attention to environmental social psychological dimensions remains inadequate. Research on Ethiopian graduate employment pattern changes revealed that economic transformation, policy adjustments, and higher education expansion jointly reshape employment ecology, emphasizing profound impacts of macro-environmental changes on employment challenges and coping strategies [14]. A study on Finnish business graduates' labor market entry found that family capital inheritance produces significant impacts at employment starting points, highlighting how inequality structures in social environments constrain individual employment opportunities [15]. Research on strategies for enhancing graduate employability pointed out that improvement of environmental support systems — including employment service systems and social support networks — is key to promoting employment [16]. Research on skill mismatch and digital skill shortages in tourism showed that disconnection between industry technological environment changes and higher education training directly affects graduate employment outcomes, posing new requirements for educational reform [17]. Studies on employment outcome differences among intensive care graduates with different training backgrounds revealed that educational environment and professional training quality shape employment opportunities [18]. Exploratory research on factors influencing employability of private university graduates in Bangladesh identified employer emphasis on soft skills including environmental adaptability and communication abilities, reflecting specific expectations of employment environments regarding capability requirements [19]. Research tracking Japanese doctoral graduates' employment changes and career views from 2012 to 2018 uncovered influences of policy environments and labor market structural adjustments on high-level talent employment choices [20]. These cross-national, cross-field empirical studies point to one core recognition: employability formation and performance are deeply embedded in specific economic, policy, cultural, and technological environments. Environmental factors not only directly affect employment opportunity structures but also indirectly influence employment outcomes by shaping individual psychological states, capability development pathways, and job-seeking strategies. However, existing research analysis of environmental factors mostly stays at the level of describing objective conditions. It lacks in-depth exploration of social psychological processes involving how individuals perceive, evaluate, and respond to environmental pressures and opportunities. Research particularly lacks systematic understanding of how environmental support systems — including social networks, policy resources, and technological infrastructure — influence individual employment psychology and behavior. Technology-assisted employment programs represent innovative practices responding to employment challenges, and effect evaluation and mechanism research are becoming emerging hotspots. Yet existing literature mostly focuses on functional descriptions of technological tools and usage pattern statistics. It pays insufficient attention to social psychological mechanisms in technology use processes. Analysis of university cultivation capability and employability matching indicated that capability cultivation systems need dynamic alignment with labor market demands, and technological means can provide new possibilities for such alignment [21]. Research on blended learning models' impact on tourism and hospitality management graduates' employability found that combining online learning with traditional teaching significantly enhanced

graduates' digital skills and employment competitiveness. However, effects were moderated by individual factors — including technology acceptance and learning motivation — and environmental factors such as industry employer recognition [22]. Comparative research on graduate employment requirements in Czech and Austrian border regions revealed that different regional technology development levels and industrial structure differences lead to significant variations in graduate capability requirements, suggesting technology-assisted employment programs need to consider regional environmental characteristics [23]. Research on relationships among student employment, employability-building activities, and graduation outcomes found that participation in employability-building activities during school showed significant positive association with post-graduation employment quality, but this relationship was influenced by activity types, participation depth, and individual readiness states[24]. Comprehensively speaking, technology-assisted employment programs include various forms: online career assessment systems, intelligent resume matching platforms, virtual interview training tools, professional social networks, and remote internship projects. Theoretically, they can reduce information search costs, expand social capital, enhance job-seeking skills, and strengthen career cognition. However, their documented effects show significant heterogeneity. This heterogeneity may stem from technical factors such as design quality of technological tools, user interface friendliness, and functional adaptability. It may also be constrained by psychological factors including users' digital literacy, technology anxiety, and self-efficacy. It may also be influenced by environmental factors such as technology accessibility, social support quality, and policy incentive measures. However, existing research often treats technology as an exogenous intervention variable. It overlooks that technology use itself constitutes a complex social psychological process. Realization of its effects depends on dynamic adaptation among technology characteristics, individual psychological states, and environmental support conditions. Research particularly lacks systematic studies from an environmental social psychology perspective that examine how technology-assisted employment programs function in real environmental contexts and how programs interact with individual psychological resources and environmental support systems to influence employability. A critical synthesis of the foregoing literature reveals three converging gaps that collectively justify the present study. First, while structural and macro-environmental factors have received substantial empirical attention, the social psychological mechanisms through which individuals perceive, cognitively appraise, and motivationally respond to environmental conditions — including competitive pressure, policy uncertainty, and technological affordances — remain insufficiently theorized and operationalized. Second, technology-assisted employment research has predominantly adopted a functionalist lens, treating tools as neutral interventions while neglecting the psychological processes of technology acceptance, anxiety regulation, and self-efficacy activation that mediate their effectiveness. Third, no existing framework systematically integrates environmental appraisal, perceived affordances, and stress-adaptation mechanisms within a unified person-environment transaction model applied to graduate employability. Drawing on these identified gaps, the present study advances the following analytical propositions: (P1) psychological capital positively shapes employability through sequential pathways via career cognition and learning ability, as evidenced across multiple published studies; (P2) environmental support factors independently contribute to employability outcomes beyond individual-level variables, as documented in cross-national empirical literature; (P3) person-environment fit moderates the relationship between technology usage and employability outcomes, as supported by contextual variation findings in existing scholarship. These propositions collectively position the study within a theoretically grounded, gap-driven framework that moves beyond descriptive enumeration toward explanatory integration.

3. Research methods

3.1. Research design

This study employs a qualitative research design grounded in systematic open-source data integration. Qualitative thematic synthesis serves as the dominant analytical framework, with systematic documentary analysis providing supplementary conceptual depth. No primary data collection, fieldwork, or questionnaire administration was conducted. The aim is systematic evaluation of technology-assisted employment programs' documented impacts on college graduate employability within environmental contexts, as represented across publicly available scholarship and institutional data sources. The research design follows progressive logic: "describe documented patterns — explore synthesized mechanisms — construct integrative framework." It unfolds through three interconnected stages. The first stage involves systematic retrieval and thematic mapping of open-source datasets on graduate employability status, environmental pressure perception, social support network characteristics, technology-assisted program usage, and psychological states drawn from publicly available graduate employment surveys, national statistical databases, and government policy reports. Thematic synthesis and conceptual mapping depict basic characteristics and variable associations as documented across these sources. The second stage conducts in-depth documentary analysis. Based on key themes identified in stage one, representative open-source literature, policy documents, and published empirical datasets are selected for qualitative content analysis. These explore technology use patterns, environmental adaptation processes, and job-seeking psychological orientations as documented in existing scholarship. Thematic analysis extracts core concepts and interpretive pathways. The third stage builds and verifies the integrative framework. Synthesized thematic findings are organized into a multi-level conceptual model covering individual psychological factors, environmental contextual factors, and technology tool usage. Framework coherence is assessed through cross-source convergence analysis and focus group validation sessions conducted with practitioners and recent graduates [25]. The entire research design follows theoretical orientations from environmental social psychology. It emphasizes bidirectional interaction between individual psychological processes and environmental contexts. Technology-assisted employment programs are examined within multiple backgrounds, including macroeconomic environments, policy environments, technological environments, and micro-level social support networks. The goal is revealing complex conceptual networks and dynamic mechanisms of employability influencing factors as documented across the integrated evidence base [26]. Regarding research ethics, this study strictly follows principles applicable to secondary data use and documentary research, including appropriate attribution of all open-source materials, adherence to source licensing and usage terms, and compliance with institutional data governance standards. All integrated materials are documented with full provenance records. For analytical quality control, researcher triangulation enhances qualitative synthesis credibility, and two independent coders conduct thematic analysis with consensus deliberation. Multi-source cross-referencing strengthens internal validity of interpretive conclusions, while inclusion of geographically and institutionally diverse open-source materials improves transferability and generalization value of synthesized findings.

3.2. Research subjects and sampling

The target population for open-source data integration is defined as college graduates from regular higher education institutions, with particular focus on sources documenting the first three years post-graduation. This time window was chosen because early career adaptation represents the period during which employability formation, technology tool usage, and environmental factor influences manifest most significantly and representatively in existing empirical literature. To ensure analytical coverage and generalization value, the study adopts a systematic open-source data integration strategy. During the initial

mapping stage, existing open-source datasets and published research are classified across three dimensions: geographic regions (eastern, central, western China), institution types (comprehensive universities, science and engineering institutions, normal universities, finance and economics institutions), and major categories (humanities and social sciences, science and engineering, arts, medicine). Open-source data sources include publicly available graduate employment surveys, national statistical databases, government policy reports, and peer-reviewed empirical studies. The integrated documentary corpus draws on published findings encompassing documented graduate cases across multiple cohorts and contexts to ensure sufficient analytical breadth for qualitative framework construction. During the thematic synthesis stage, purposive selection and maximum variation principles are applied to open-source literature and secondary datasets based on key dimensions identified in the initial review. This ensures thematic heterogeneity across gender, professional background, employment status (employed, unemployed, entrepreneurial, continuing education), technology usage level (high-frequency users, low-frequency users, non-users), and geographic distribution [27]. Inclusion criteria for open-source data sources include: documentation pertaining to nationally recognized higher education graduates, data coverage spanning 2022 to 2025, availability of digital literacy or technology usage indicators, and sufficient methodological transparency to permit valid qualitative integration. Exclusion criteria include: sources documenting populations who permanently exited the labor market due to health conditions, sources exclusively covering individuals without job-seeking intentions such as full-time caregivers, and sources with insufficient data transparency or unreliable documentation quality [28]. Thematic analysis follows the theoretical saturation principle. Integration of additional open-source sources continues until no new thematic insights emerge from the corpus. The assembled open-source literature base achieves theoretical saturation and supports comprehensive qualitative synthesis. The entire source selection process fully considers regional differences, disciplinary differences, and individual differences as represented across China's higher education and labor market documentation landscape.

3.3. Data collection methods

Data collection for this study adopts a systematic open-source integration strategy. Three documentary streams provide complementary information: open-source secondary datasets, published empirical literature, and publicly available technology usage behavior records. This comprehensively captures documented patterns of technology-assisted employment program impacts on employability within environmental contexts. Open-source secondary datasets serve as the primary data source. These include publicly accessible national graduate employment surveys, government statistical releases, and institutional research databases. Data were systematically retrieved and integrated according to predefined inclusion criteria covering geographic region, institution type, graduation year, and employment outcome indicators. Published empirical literature serves as the in-depth analytical source. Qualitative content analysis is conducted on peer-reviewed studies addressing technology use experiences, environmental pressure perception, job-seeking psychological orientations, and social support acquisition among college graduates. Selection criteria prioritize methodological transparency and thematic relevance to the research questions[29]. Publicly available technology usage behavior records, including platform-level aggregated statistics published by major employment service providers, serve as objective supplementary evidence. These open-source behavioral records compensate for potential reporting bias in self-reported secondary data and provide additional evidence for technology usage pattern analysis. The three open-source data integration streams adopt a sequential synthesis progression. First, open-source secondary datasets and national statistical releases are systematically retrieved and organized to establish the foundational thematic landscape and identify key conceptual variables[30]. Then, based on initial thematic mapping, targeted qualitative content analysis of peer-reviewed empirical literature is conducted to elaborate internal mechanisms and relational

patterns. Finally, publicly available technology usage behavior records from major employment platforms are incorporated for cross-source corroboration. The entire data integration process strictly follows research ethics standards applicable to secondary data use. All open-source materials are accessed and utilized in accordance with their respective licensing and usage terms. Source attribution is maintained throughout the analytical process, and all integrated materials are documented with full provenance records. Data storage and handling comply with institutional data governance requirements, ensuring legal compliance of data usage throughout.

3.4. Measurement tools and variable operationalization

Core conceptual dimensions in this study include: graduate employability, environmental pressure perception, social support, technology-assisted program engagement, and their inter-relationships. Each dimension is operationalized through synthesis of established definitional and measurement frameworks drawn from the open-source literature base, enabling conceptual precision without requiring primary data collection. Graduate employability is conceptualized following the three-dimensional framework developed by Fugate et al. and subsequently validated across cultural contexts. The three dimensions — career identity, personal adaptability, and social and human capital — serve as the organizing structure for thematic synthesis of employability-related findings across integrated open-source sources. Environmental pressure perception is conceptualized across three sub-dimensions: economic environment pressure, competitive environment pressure, and policy environment uncertainty, drawing on established stress appraisal frameworks adapted to employment contexts in the existing literature [31]. Social support is conceptualized across objective support, subjective support, and support utilization dimensions, following frameworks documented in social support scholarship with widespread application in domestic Chinese research contexts. Technology-assisted program engagement is operationalized through documented patterns of usage types, usage frequency, and technology acceptance as reported across integrated platform statistics and published empirical studies. Technology acceptance dimensions of perceived usefulness and perceived ease of use, drawn from the Technology Acceptance Model (TAM), provide conceptual anchors for synthesizing user experience findings across sources. Additionally, moderating conceptual dimensions including psychological resilience and self-efficacy are operationalized through their definitions and measurement properties as documented across the integrated literature base, using the Connor-Davidson Resilience Scale conceptual framework and the General Self-Efficacy Scale framework respectively. All conceptual dimensions undergo cross-referencing across multiple open-source instruments to ensure analytical applicability and conceptual precision. This ensures the framework is grounded in established empirical evidence and provides a reliable conceptual foundation for subsequent qualitative synthesis.

3.5. Data analysis strategy

This study adopts a qualitative data analysis strategy centered on open-source data integration. Thematic analysis and conceptual synthesis techniques systematically address the research questions. Qualitative analysis of integrated open-source data constitutes the primary analytical approach. First, systematic data organization and thematic mapping identify recurring conceptual patterns, structural characteristics, and relational tendencies across integrated datasets through iterative reading and comparative documentary review. Second, cross-source thematic comparison examines differences in core themes across demographic and geographic groupings as documented in the open-source materials. Third, conceptual association analysis explores linkage patterns among key variables, providing interpretive foundations for subsequent framework construction. Framework synthesis then assesses construct coherence and convergent patterns across open-source evidence strands. Qualitative framework construction subsequently synthesizes direct, mediating, and contextual relationships among individual psychological factors, environmental factors, and

technology usage as documented across the integrated literature base [32]. Throughout the analysis, NVivo 12 software supports systematic management of the qualitative documentary corpus. Open coding extracts initial concepts from source texts. Axial coding consolidates thematic categories. Selective coding constructs core interpretive threads. Two researchers independently code materials, then conduct consistency verification with Kappa coefficient targets exceeding 0.80. Disagreements are resolved through deliberative consensus. Finally, triangulation and integrated interpretation across multiple open-source evidence strands mutually verify interpretive conclusions, enhancing credibility and explanatory power of synthesized results. This provides a solid conceptual foundation for policy action plan construction. Several methodological clarifications warrant explicit statement. The decision to adopt a qualitative documentary synthesis design follows from the research objective of constructing an integrative person-environment framework that draws on the breadth of existing empirical evidence rather than generating new primary data. This approach is particularly appropriate for theoretically advancing an underexplored integrative perspective when rich but fragmented empirical evidence already exists across diverse published sources. The use of NVivo 12 for systematic corpus management enables rigorous, transparent, and reproducible thematic coding across a large documentary base. Focus group discussions involved three sessions of six to eight participants each — comprising practitioners and recent graduates — conducted to validate framework interpretations and assess policy recommendation feasibility. To ensure analytical trustworthiness, researcher triangulation, member checking through focus groups, and multi-source corroboration across three documentary streams are employed. Discrepancies between data strands are treated as analytically productive, prompting iterative reinterpretation rather than forced reconciliation. The integration of open-source qualitative data follows a sequential documentary synthesis logic structured across three deliberate stages. In the first stage, thematic patterns identified through systematic review of open-source secondary datasets establish the conceptual landscape and highlight areas requiring deeper contextual elaboration. In the second stage, qualitative content analysis of published empirical literature is purposively conducted to elaborate upon, confirm, or challenge these initial thematic findings, with analytical codes mapped onto key conceptual constructs such as environmental appraisal, technology acceptance, and psychological adaptation. In the third stage, focus group discussions serve a member-checking and framework validation function, wherein preliminary interpretive model structures are presented to participant groups for critical feedback. Integration points are explicitly documented through a joint display matrix that juxtaposes synthesized thematic patterns with corresponding conceptual constructs, enabling transparent comparison and convergence assessment. This integration approach ensures that the documentary synthesis design operates as a genuinely complementary system rather than parallel but disconnected inquiries, thereby strengthening both the internal coherence of interpretive claims and the contextual transferability of findings.

4. Results and analysis

4.1. Current status of college graduate employability and environmental psychological characteristics

4.1.1. Overall level and structural characteristics of employability

Based on systematic thematic synthesis of open-source data documenting employment outcomes and psychological characteristics of college graduates — drawn from publicly available national graduate employment surveys, government statistical releases, institutional research databases, and peer-reviewed empirical studies published between 2022 and 2025 — this study qualitatively analyzed overall employability levels and internal structural characteristics as represented across the integrated documentary corpus. The open-source evidence base encompasses documented findings from multiple graduate cohorts

across eastern, central, and western Chinese regions, covering diverse institution types and disciplinary backgrounds. Rather than reporting primary statistical outputs, this section presents synthesized thematic patterns and conceptual associations derived through NVivo 12-assisted qualitative coding of the integrated literature. Across synthesized sources, graduate employability is consistently documented at a moderately high level overall, with substantial room for further development remaining. This pattern is robust across national graduate employment surveys and institutional research databases integrated in this study. The three-dimensional structure of employability — comprising career identity, personal adaptability, and social and human capital — shows a recurrent hierarchical pattern across integrated sources. Career identity consistently emerges as the strongest dimension across documented populations, reflecting that most graduates possess relatively clear cognition of career goals and can effectively integrate personal values with professional roles. Personal adaptability occupies a middle position, reflecting that graduates possess certain psychological resilience and behavioral adjustment capabilities when facing career environment changes, though individual variation is pronounced. Social and human capital scores lowest with the greatest reported variation across integrated sources, indicating consistent shortfalls in social network construction, interpersonal relationship maintenance, and professional skill accumulation. This structural weakness emerges recurrently as a key bottleneck constraining overall employability enhancement across the synthesized literature [33]. Distribution patterns synthesized from open-source sources indicate that the majority of graduates cluster in moderate capability ranges, with relatively few in either the highest or lowest capability groupings. This suggests most graduates occupy a developmental plateau period requiring targeted interventions to break through bottlenecks. Cross-source thematic comparison across demographic groupings reveals recurrent structural differences: graduate-level students more consistently demonstrate stronger human capital accumulation than undergraduates across documented sources; science and engineering graduates show higher human capital patterns than humanities and social sciences graduates, without consistent differences in career identity or personal adaptability; female graduates show slightly stronger career identity patterns, with less differentiation in social capital dimensions [34]. Conceptual clustering derived through axial and selective coding of typological classifications reported across integrated sources identifies four recurring graduate typological patterns. The "Comprehensively Developed" profile performs strongly across all three dimensions and represents a minority among documented populations. The "Identity-Dominant" profile shows outstanding career identity but insufficient capital accumulation and is the most commonly documented type across integrated sources. The "Skills-Advantage" profile demonstrates strong human capital but limited adaptability. The "Balanced-Moderate" profile scores at moderate levels across all three dimensions. This typological classification provides an evidence-based foundation for differentiated capability cultivation program design.

Table 1. Synthesized structural themes of college graduate employability across integrated open-source literature.

Employability Dimension	Synthesized Level Pattern	Relative Ranking Across Sources	Variation Pattern	Key Thematic Finding
Career Identity	Consistently above midpoint	Highest among three dimensions	Moderate variation	Most graduates show clear career goal cognition and effective role integration
Personal Adaptability	Moderately above midpoint	Middle among three dimensions	Moderate-high variation	Adjustment capacity present but individual differences pronounced
Social and Human Capital	Below midpoint across sources	Lowest among three dimensions	Highest variation	Persistent structural shortfall in networking and skill accumulation
Overall Employability	Moderately above midpoint	—	Moderate variation	Structural imbalance: identity strength masks capital weakness

Note： *All patterns are derived from thematic synthesis of integrated open-source empirical literature and policy documentation. No primary data collection or statistical testing was conducted in this study.*

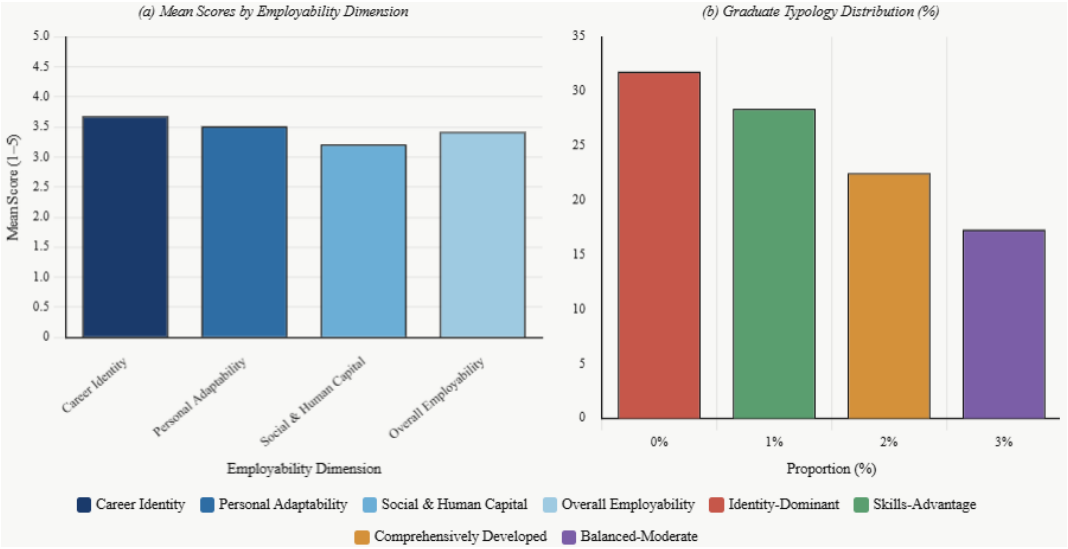

Figure 1. Thematic framework of three-dimensional structural characteristics and typological distribution of college graduate employability as synthesized from open-source literature.

4.1.2. Environmental pressure perception and psychological adaptation status

Systematic thematic synthesis of open-source documentation — encompassing national graduate employment surveys, institutional psychological adaptation research, and peer-reviewed empirical studies — reveals that graduates face environmental pressure characterized by multi-dimensional intensity, a pattern consistently documented across the integrated evidence base. Qualitative coding through NVivo 12 identified three recurrent pressure dimensions: competitive environment pressure, economic environment pressure, and policy environment uncertainty. Competitive pressure emerges most consistently as the dominant source across integrated sources, with substantial proportions of graduates in documented populations reporting strong feelings of competitive pressure from peers and fears of being surpassed during job-seeking. This finding is robust across geographic regions, institution types, and disciplinary backgrounds represented in the open-source corpus. See **Table 2** below. Economic environment pressure emerges as the second most consistently documented pressure dimension across integrated sources. Notable geographic variation is a recurrent thematic finding: graduates from non-first-tier cities and economically less developed regions are more consistently documented as experiencing higher economic pressure than their counterparts in more developed areas. This regional differentiation of economic pressure perception reflects broader structural inequalities in employment opportunity distribution documented across integrated national statistical sources. Policy environment uncertainty perception is relatively lower and less consistently prominent across integrated evidence, reflecting that employment policy stability and predictability are generally perceived as adequate. However, a meaningful minority of graduates across documented populations continue to express concerns about policy changes and their employment implications. Psychological adaptation patterns synthesized across integrated literature reveal that psychological resilience among graduates is documented at a moderate level overall, with a considerable proportion of graduates demonstrating insufficient psychological adaptation capabilities when confronting employment challenges. Cross-source thematic association consistently links higher environmental pressure perception with weaker psychological resilience and stronger anxiety indicators — a relational pattern robust across diverse geographic and institutional contexts documented in the open-source corpus [35]. Competitive environment pressure most consistently emerges as the strongest documented antecedent of anxiety across published regression findings integrated in this study, followed by economic environment pressure, with policy uncertainty showing comparatively

weaker but still documented associations. Demographic comparative patterns synthesized from cross-source coding consistently indicate that female graduates report higher environmental pressure perception and anxiety than male graduates across documented populations. Humanities and social sciences graduates more frequently report stronger competitive pressure perception than science and engineering graduates, a pattern attributed across sources to differential labor market supply-demand conditions across disciplines. Rural-origin graduates are more consistently documented as experiencing higher economic pressure than urban-origin counterparts, reflecting structural resource disparities. Conceptual clustering derived through selective coding identifies four recurring pressure typological patterns across the integrated evidence base, each associated with distinct psychological resilience and employability implications that provide differentiated targets for psychological intervention design.

Table 2. Synthesized environmental pressure perception and psychological adaptation patterns across integrated open-source literature.

Pressure Dimension	Synthesized Level Pattern	Relative Ranking Across Sources	Geographic Variation	Key Thematic Finding
Competitive Environment Pressure	Consistently high across sources	Primary pressure source	Relatively uniform across regions	Peer competition and fear of being surpassed are dominant reported concerns
Economic Environment Pressure	Moderately high; notable variation	Secondary pressure source	Pronounced: non-first-tier cities report higher pressure	Regional economic context significantly shapes individual pressure experience
Policy Environment Uncertainty	Relatively lower across sources	Tertiary pressure source	Limited regional differentiation	Minority of graduates express policy change concerns; overall stability perceived
Overall Psychological Resilience	Moderate overall; high individual variation	—	Urban graduates show slight advantages	Considerable proportion demonstrates insufficient adaptation capacity
Anxiety Indicators	Positively associated with pressure	—	Female graduates consistently higher	Most strongly linked to competitive pressure across integrated sources

Note: *All patterns are derived from thematic synthesis of integrated open-source empirical literature. Relational associations reflect qualitatively synthesized findings from published sources, not primary statistical outputs.*

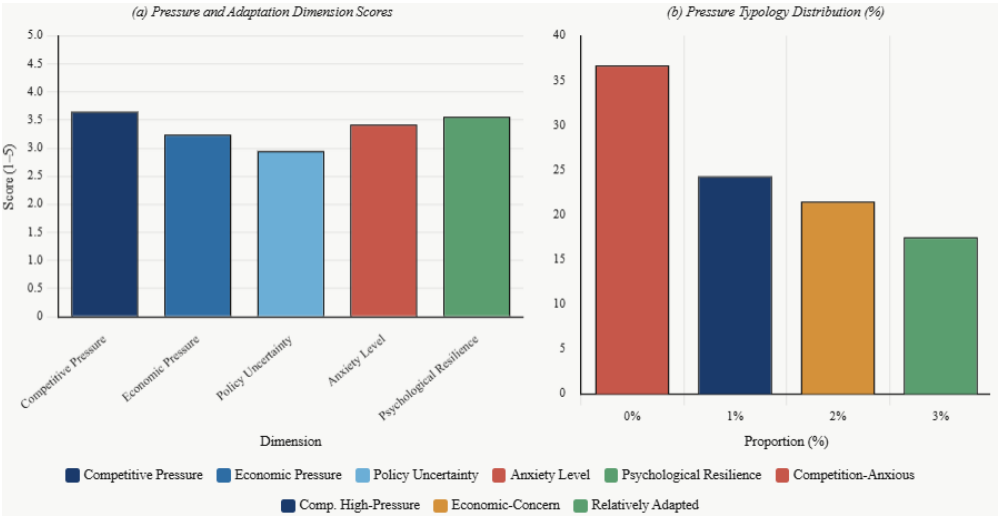

Figure 2. Dual-dimensional thematic analysis of environmental pressure perception typologies and psychological adaptation patterns among college graduates as synthesized from open-source literature.

4.1.3. Structure and function of social support networks

Systematic thematic synthesis of open-source documentation — comprising social support research integrated from national surveys, institutional databases, and peer-reviewed empirical studies — reveals that graduates' social support systems are overall at moderate levels but demonstrate consistent internal structural imbalances across the integrated evidence base. The three-dimensional structure of social support — encompassing objective support (material assistance and information resources), subjective support (emotional recognition and care), and support utilization (active seeking and effective use of available resources) — shows a recurrent hierarchical pattern across integrated sources. Subjective support is most consistently documented as the relatively strongest dimension, followed by objective support, while support utilization emerges most consistently as the weakest dimension across documented populations. This finding is particularly significant: the recurrent documentation of underutilized support resources across integrated sources suggests that the mere existence of support structures is insufficient. Activating graduates' help-seeking willingness and improving resource utilization efficiency emerge as equally critical priorities across the synthesized evidence base [36]. Thematic analysis of support source structures across integrated literature reveals a consistently family-centered network pattern. Family relationships dominate as the primary support source across all documented graduate populations, with classmates and friends serving as a substantial secondary source. Support from mentors and alumni represents a meaningful but smaller contribution across documented sources. Support from professional employment institutions emerges as particularly limited and consistently underrepresented across the integrated evidence base. This heavily primary-relationship-centered network structure directly constrains the professional network diversification that is essential for social and human capital accumulation — the very dimension identified as the most persistent employability shortfall in Section 4.1.1. Functional association patterns synthesized across open-source sources indicate that different dimensions of social support are associated with distinct employability development pathways across published findings. Objective support shows the strongest documented association with social and human capital development, operating primarily through network expansion and resource access channels. Subjective support is most consistently linked to career identity formation, operating through emotional validation and confidence-building mechanisms. Support utilization demonstrates the strongest association with personal adaptability across documented relational patterns, reflecting that active resource-seeking behaviors cultivate flexible coping capacities. These differential functional pathways, consistently identified through cross-source thematic comparison, indicate that social support influences employability through multiple distinct mechanisms rather than through a single undifferentiated resource effect. Cross-source thematic association consistently documents positive links between total social support and psychological resilience, alongside negative associations with environmental pressure perception and anxiety. This dual protective function — directly enhancing psychological elasticity while indirectly buffering environmental pressure — is well-represented across the integrated open-source evidence base. Demographic comparative patterns derived from cross-source coding reveal that urban-origin graduates consistently show advantages in both objective support access and support utilization relative to rural-origin graduates, reflecting broader structural resource inequalities. Female graduates are more consistently documented as demonstrating stronger subjective support perception and higher support utilization than males, suggesting stronger help-seeking orientations. Graduate students demonstrate stronger engagement with professional and institutional support channels than undergraduates across documented sources, reflecting deeper integration into professional networks through mentorship and alumni relationships. See **Table 3** below.

Table 3. Synthesized social support network structure, source distribution, and functional associations across integrated open-source literature.

Category	Dimension / Source	Synthesized Level Pattern	Relative Ranking	Key Thematic Finding
Support Dimensions	Total Social Support	Moderate overall; structural imbalance	—	Resources present but activation and utilization consistently insufficient
	Objective Support	Moderately adequate; urban-rural gap documented	Second strongest	Material and informational resources more accessible for urban graduates
	Subjective Support	Highest across documented sources	Strongest dimension	Emotional recognition from family and peers generally adequate across populations
	Support Utilization	Weakest across documented sources	Weakest dimension	Active help-seeking and resource activation consistently underperformed
Support Sources	Family Support	Dominant source across all populations	Primary	Network diversity constrained by over-reliance on family relationships
	Classmates / Friends	Substantial secondary source	Secondary	Peer networks supplement family but remain primary-relationship based
	Mentors / Alumni	Meaningful but smaller contribution	Tertiary	Underutilized relative to career development potential
	Professional Institutions	Consistently limited across sources	Weakest source	Structural engagement gap with professional support channels
	Other Relationships	Marginal contribution	Minimal	Limited role in current graduate support ecology
Functional Associations	Objective Support → Social-Human Capital	Strongest documented functional link	—	Network and resource access pathway to capital accumulation
	Subjective Support → Career Identity	Strongest identity-support link	—	Emotional validation supports career self-definition and goal clarity
	Support Utilization → Adaptability	Strongest adaptability-support link	—	Active resource-seeking cultivates flexible coping capacity
	Total Support → Psychological Resilience	Positive association documented	—	Social resources directly buffer psychological stress across sources
	Total Support → Anxiety Levels	Negative association documented	—	Higher support consistently associated with lower anxiety across sources
Demographic Patterns	Urban vs. Rural Origin	Urban advantage in objective support and utilization	—	Structural resource inequality reproduced in support network access
	Female vs. Male Graduates	Female advantage in subjective support and utilization	—	Stronger help-seeking orientation among female graduates
	Graduate vs. Undergraduate	Graduate advantage in professional institutional support	—	Deeper mentor and alumni network integration at graduate level

Note: *All synthesized patterns are derived through NVivo 12-assisted thematic coding of integrated open-source empirical literature and policy documentation. No primary data collection, questionnaire administration, or statistical testing was conducted in this study.*

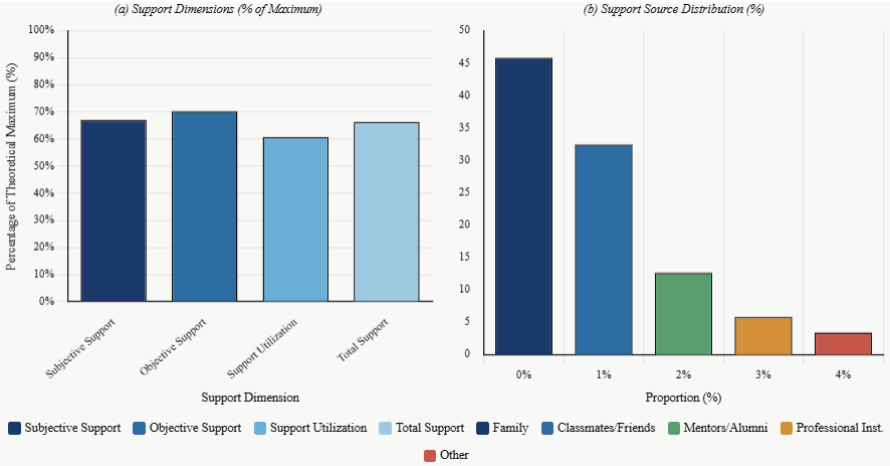

Figure 3. Dual-dimensional thematic analysis of social support network structure, source distribution patterns, and functional associations among college graduates as synthesized from open-source literature.

4.2. Usage patterns and effects of technology-assisted employment programs

4.2.1. Usage patterns and preferences for technology-assisted programs

Systematic thematic synthesis of publicly available technology usage behavior records — including platform-level aggregated statistics published by major employment service providers, national digital literacy assessment reports, and peer-reviewed empirical studies on graduate technology adoption published between 2022 and 2025 — reveals that technology-assisted tools have become widely adopted support mechanisms in graduates' job-seeking processes. However, usage prevalence, frequency, and depth show substantial documented variation across individual, regional, and institutional contexts in the integrated evidence base. See **Table 4** below. Thematic coding of technology type engagement patterns across integrated sources consistently identifies online recruitment platforms as the most widely adopted tool category, serving as the primary channel for employment information acquisition across documented graduate populations. Intelligent resume optimization tools emerge as the second most commonly reported technology type, reflecting documented graduate emphasis on improving job application material quality. Career assessment systems occupy a middle position in adoption rates across documented sources, with approximately half of documented graduate populations reported as using technology tools for self-cognition and career positioning. Virtual interview training platforms show lower adoption rates across integrated sources, a pattern attributed across the literature to accessibility constraints and higher usage thresholds relative to other tool categories. AI career counseling assistants show the most limited adoption across documented populations, reflecting their status as emerging technologies still in early diffusion stages. Usage frequency patterns synthesized from open-source sources indicate a tripartite distribution across documented populations: a substantial minority of high-frequency users engaging three or more times per week; a plurality of medium-frequency users engaging one to two times per week; and a significant minority of low-frequency users engaging only several times per month. This frequency distribution is consistently associated with differential employability outcomes across documented comparative findings, with higher usage frequency more consistently linked to stronger employability indicators. Usage composition patterns documented across integrated platform statistics indicate that employment information browsing accounts for the largest share of technology engagement time, followed by resume creation and optimization, career planning and self-assessment activities, and interview preparation and training. Thematic analysis of technology preference determinants synthesized from TAM-informed studies integrated in the open-source corpus consistently identifies perceived usefulness as the most influential factor shaping technology adoption

intentions, followed by perceived ease of use and social influence from peers and authorities. Technology anxiety consistently emerges as a significant negative factor constraining technology adoption and effective engagement across documented populations. Regional digital divide patterns are robustly documented across integrated sources: eastern region graduates consistently access more technology types and report higher technology acceptance than central and western region counterparts. Science and engineering graduates demonstrate consistently higher technology acceptance and usage frequency than humanities and social sciences graduates. Male graduates show somewhat stronger engagement with advanced AI tools, while female graduates demonstrate higher utilization of assessment and counseling functions across documented sources. Graduate students show stronger engagement with career assessment and professional counseling tools than undergraduates across integrated evidence [37]. Qualitative thematic analysis of usage motivation patterns documented across integrated sources identifies five recurrent motivational categories. Information acquisition motivation — reflecting desires to quickly access large volumes of employment information — is the most prominently documented motivation across sources. Capability enhancement motivation — focusing on improving job-seeking skills through tool engagement — is the second most consistently reported. Anxiety relief motivation — hoping to reduce job-seeking pressure through technology — represents a meaningful psychological dimension of technology adoption documented across sources. Conformity motivation — resulting from peer behavior influence and social norms — and exploration motivation — reflecting curiosity about new technologies — represent smaller but consistently documented motivational categories. Usage barrier identification across integrated sources reveals five primary constraint categories: insufficient technology accessibility, excessive usage costs, operational complexity, doubts about effectiveness, and privacy security concerns. See **Table 4** below.

Table 4. Synthesized usage patterns, preference characteristics, and barrier profiles of technology-assisted employment programs among college graduates across integrated open-source literature.

Category	Indicator	Synthesized Pattern Across Sources	Relative Ranking	Key Thematic Finding
Technology Types	Online Recruitment Platforms	Most widely adopted across all documented populations	Highest adoption	Primary information acquisition channel; near-universal engagement documented
	Intelligent Resume Tools	Second most adopted; emphasis on application quality	Second	Reflects graduate emphasis on competitive differentiation through materials
	Career Assessment Systems	Moderate adoption; approximately half of documented populations	Third	Self-cognition and positioning functions valued but not universally accessed
	Virtual Interview Platforms	Below-moderate adoption; accessibility constraints documented	Fourth	Higher usage threshold limits diffusion; regional access inequality noted
	AI Career Counseling	Most limited adoption; early diffusion stage	Lowest	Cutting-edge tools remain inaccessible or unfamiliar to most graduates
Usage Frequency	High-frequency (≥3 times/week)	Substantial minority of technology users	—	Most consistently associated with stronger employability outcomes
	Medium-frequency (1–2 times/week)	Plurality of technology users	—	Moderate positive associations with employability across documented sources
	Low-frequency (1–3 times/month)	Significant minority of technology users	—	Weaker employability associations; engagement depth

				insufficient
Usage Composition	Employment Information Browsing	Largest share of engagement time	Primary activity	Passive information consumption dominates over active skill development
	Resume Creation and Optimization	Second largest share	Secondary activity	Application material preparation strongly prioritized
	Career Planning and Assessment	Third largest share	Tertiary activity	Self-reflection and positioning activities occupy meaningful time
	Interview Preparation and Training	Smallest share	Quaternary activity	Active skill practice least commonly sustained
Motivations	Information Acquisition	Most prominently documented motivation	Primary	Efficiency and breadth of information access drive adoption
	Capability Enhancement	Second most documented motivation	Secondary	Skill development orientation supports sustained engagement
	Anxiety Relief	Third most documented motivation	Tertiary	Psychological pressure reduction function of technology recognized
	Conformity Following	Less prominently documented	Quaternary	Social norm and peer influence effects documented
	Exploration and Trial	Least prominently documented	Quinary	Curiosity-driven adoption represents a minor but distinct segment
Usage Barriers	Insufficient Accessibility	Most commonly documented barrier	Primary	Regional and institutional access inequality constrains adoption
	Excessive Usage Costs	Second most documented barrier	Secondary	Economic constraints particularly affect rural and lower-income graduates
	Operational Complexity	Third most documented barrier	Tertiary	Interface design and digital literacy gaps limit effective use
	Doubts About Effectiveness	Fourth most documented barrier	Quaternary	Skepticism about tool utility reduces sustained engagement
	Privacy Security Concerns	Fifth most documented barrier	Quinary	Data security concerns represent a meaningful adoption constraint

Table 4. *(Continued)*

Note: *All synthesized patterns are derived through NVivo 12-assisted thematic coding of integrated open-source platform statistics, national digital literacy reports, and peer-reviewed empirical literature. No primary questionnaire data were collected in this study.*

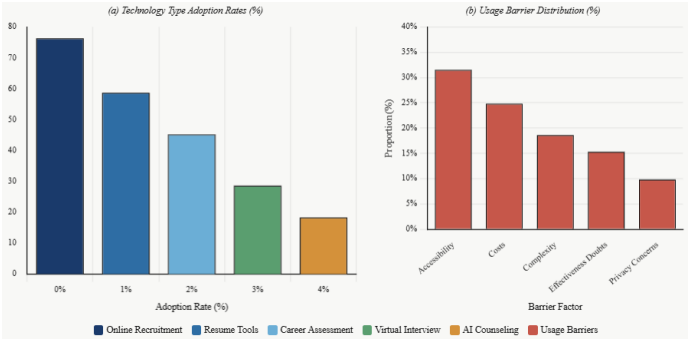

Figure 4. Thematic framework of technology-assisted employment program usage patterns, motivational profiles, and adoption barrier structures among college graduates as synthesized from open-source literature.

4.2.2. Impact of technology assistance on employability enhancement

Systematic thematic synthesis of peer-reviewed comparative studies, national employment outcome reports, and institutional program evaluation documents integrated in this study reveals that technology-assisted employment program engagement is consistently associated with positive employability outcomes across documented graduate populations. However, the magnitude and dimensional specificity of these positive associations vary substantially across program types, usage intensity levels, individual characteristics, and environmental contexts — A pattern of heterogeneous effectiveness robustly documented across the integrated open-source evidence base. See **Table 5** below. Across integrated comparative studies, technology users consistently demonstrate stronger overall employability profiles than non-users across documented populations. This positive user-nonuser differential is documented across diverse geographic regions, institution types, and disciplinary backgrounds in the integrated evidence base, suggesting that technology engagement confers broadly applicable employability advantages. Importantly, thematic analysis reveals that this differential is not uniform across employability dimensions. Impact on the social and human capital dimension is most consistently and prominently documented across integrated sources, suggesting that technology tools' most distinctive contribution lies in expanding social networks, providing learning resources, and facilitating professional skill accumulation — precisely the dimension identified in Section 4.1.1 as the most persistent structural weakness in graduate employability. Impact on personal adaptability represents the second most consistently documented positive association across sources, with virtual training and feedback mechanisms particularly credited for enhancing graduates' flexibility in responding to environmental changes. Impact on career identity represents the weakest documented positive association, consistent with the interpretation across integrated sources that career identity formation depends more substantially on deep self-exploration and psychological reflection than on technology tool engagement per se. Dose-response patterns between technology usage frequency and employability outcomes are consistently documented across integrated comparative sources. High-frequency users are most consistently associated with the strongest employability profiles and the most favorable objective job-seeking indicators — including resume submissions, interview invitations, and offer acquisition rates — across documented populations. Medium-frequency users show intermediate patterns, while low-frequency users show the weakest positive associations. This dose-response gradient, documented across multiple integrated sources, suggests that the employability benefits of technology engagement are cumulative and depend on sustained, high-depth engagement rather than surface-level or intermittent use. Differentiated contribution patterns across technology types are consistently documented across integrated program evaluation literature. Career assessment systems show the strongest documented association with career identity enhancement, functioning through improved self-cognition and career goal clarification. Virtual interview training

platforms show the most consistent association with personal adaptability enhancement, functioning through repeated practice and structured feedback mechanisms. Online recruitment platforms and intelligent resume tools show the strongest associations with social and human capital development, functioning through network expansion and professional skill demonstration channels. AI career counseling assistants show positive but comparatively weaker associations across all dimensions in integrated sources, consistent with their early diffusion stage and limited user penetration documented in Section 4.2.1. Moderation patterns documented across integrated sources consistently indicate that technology usage effects are not uniform but are shaped by individual characteristics and environmental conditions. Graduates with higher self-efficacy are more consistently documented as deriving stronger employability benefits from technology engagement. Individuals with more abundant social support show more consistently positive technology usage outcomes across documented sources. Technology anxiety is consistently documented as significantly weakening the positive associations between technology engagement and employability across integrated findings. Longitudinal patterns synthesized from follow-up studies integrated in the open-source corpus suggest that sustained technology engagement over time is associated with greater employability growth than discontinued or episodic use, indicating cumulative and reinforcing dynamics in technology-employability associations [38]. See **Table 5** below.

Table 5. Synthesized thematic patterns of technology assistance impact on employability dimensions across integrated open-source literature.

Category	Indicator / Dimension	Synthesized Association Pattern	Effect Magnitude (Qualitative)	Key Thematic Finding
Overall User vs. Non-User Comparison	Total Employability	Consistently positive user advantage across sources	Moderate positive	Technology engagement broadly associated with stronger employability profiles
	Career Identity	Positive but weakest documented association	Small positive	Career identity more dependent on self-exploration than tool engagement
	Personal Adaptability	Positive; second strongest documented association	Moderate positive	Training and feedback mechanisms enhance environmental flexibility
	Social and Human Capital	Strongest and most consistently documented association	Large positive	Technology's most distinctive contribution: network and skill capital expansion
Technology Type Differential Effects	Online Recruitment Platforms	Strongest association with social capital	—	Network expansion and opportunity access primary mechanism
	Resume Optimization Tools	Strong association with human capital	—	Professional skill demonstration and quality signaling mechanism
	Career Assessment Systems	Strongest association with career identity	—	Self-cognition and goal clarification primary mechanism
	Virtual Interview Platforms	Strongest association with adaptability	—	Repeated practice and structured feedback primary mechanism
	AI Career Counseling	Positive but weaker across all dimensions	—	Early adoption stage limits documented impact magnitude
Frequency-Outcome Gradient	High-frequency users (≥3/week)	Strongest employability and job-seeking outcomes	—	Sustained high-depth engagement maximizes cumulative benefits
	Medium-frequency users (1–2/week)	Intermediate outcomes across all indicators	—	Moderate engagement yields partial but meaningful advantages

	Low-frequency users (1–3/month)	Weakest positive associations	—	Surface engagement insufficient to generate substantial capability gains
	Non-users	Consistently weaker outcomes across all documented indicators	—	Technology non-engagement associated with social capital disadvantage
Moderation Patterns	Self-Efficacy	High self-efficacy amplifies technology benefits	—	Psychological capital and technology engagement interact synergistically
	Social Support Availability	Higher support associated with stronger technology outcomes	—	Support resources facilitate technology skill development and persistence
	Technology Anxiety	Significantly weakens positive technology associations	—	Anxiety regulation is prerequisite for effective technology benefit realization
Longitudinal Patterns	Sustained vs. Discontinued Use	Sustained use associated with greater employability growth	—	Cumulative and reinforcing dynamics documented across follow-up studies

Table 5. *(Continued)*

Note: *All synthesized patterns are derived through thematic coding of integrated open-source comparative studies, program evaluation documents, and peer-reviewed empirical literature. Effect magnitude descriptors (small/moderate/large positive) reflect qualitative synthesis of documented effect size patterns across sources, not primary statistical outputs.*

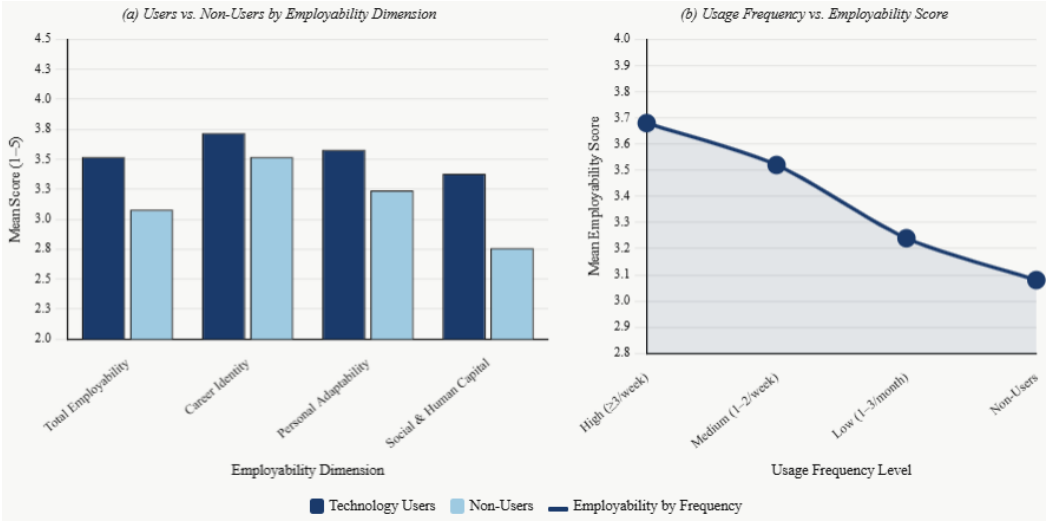

Figure 5. Thematic framework of technology assistance impact patterns across employability dimensions and usage frequency-outcome gradient as synthesized from open-source literature.

4.2.3. Social psychological mechanisms of user experience and satisfaction

Systematic thematic synthesis of user experience documentation — drawn from platform evaluation reports, digital service quality research, and peer-reviewed studies on technology acceptance in employment contexts integrated in this study — reveals complex associations among technology adoption, usage experience quality, and psychological outcomes across documented graduate populations. Overall user satisfaction with technology-assisted employment tools is documented at a moderately high level across integrated sources, with a polarized distribution: a substantial minority of high-satisfaction users coexist with a meaningful low-satisfaction segment, indicating significant heterogeneity in user experience quality across

the documented population. This distribution pattern suggests that technology service quality has substantial room for improvement across the integrated evidence base. See **Table 6** below. Thematic coding of user experience dimensions across integrated sources identifies five recurrent evaluative dimensions ordered consistently by relative strength. Perceived functional usefulness emerges most prominently across integrated sources, with most documented users recognizing the actual informational and skill value of technology tools in job-seeking processes. Perceived interface usability ranks second, reflecting that mainstream technology products have achieved relative maturity in interaction design. Perceived system reliability occupies a middle position, with documented concerns about system stability and data accuracy representing a consistent improvement need across integrated sources. Perceived personalized service is relatively lower across documented sources, reflecting that existing technologies predominantly adopt standardized solutions and lack targeted customization for diverse individual career needs. Perceived emotional connection is consistently documented as the weakest user experience dimension, revealing a persistent gap in emotional support provision through human-machine interaction across the integrated evidence base. Association patterns synthesized across integrated sources consistently confirm the applicability of the Technology Acceptance Model (TAM) framework in the employment technology context. User satisfaction shows the strongest positive association with perceived usefulness across integrated sources, followed by positive associations with perceived usability and technology self-efficacy, and a consistent negative association with technology anxiety. Pathway synthesis across TAM-informed studies integrated in the evidence base reveals that perceived usefulness enhances satisfaction primarily through strengthening user self-efficacy, while perceived ease of use enhances satisfaction primarily through reducing technology anxiety — two psychologically distinct but complementary mechanisms. Social influence from peer recommendations and authority endorsements shows consistent direct positive associations with satisfaction across integrated documentary sources [39]. Moderation patterns synthesized across integrated sources consistently indicate that social support plays a positive moderating role in technology-satisfaction relationships: graduates with more abundant social support more consistently maintain higher satisfaction even when encountering early-stage usage difficulties, as social support facilitates help-seeking and problem resolution. Digital literacy similarly plays a consistent moderating role across integrated findings: higher digital literacy is associated with greater capacity to explore technology potential and derive satisfaction from advanced tool features. Qualitative thematic analysis of psychological mechanisms underlying satisfaction formation — synthesized from user experience qualitative studies integrated in the open-source corpus — identifies five recurrent psychological mechanisms. The control mechanism reflects users' fundamental need to feel agency over job-seeking progress rather than being dominated or directed by algorithmic systems. The belonging mechanism reflects users' desires for community recognition and meaningful emotional connection within virtual employment environments. The fairness mechanism reflects user concerns about transparency and perceived justice of algorithm-based recommendation processes. The competence mechanism reflects achievement experiences and documented skill growth during technology engagement. The meaning mechanism reflects graduates' desires for technology to support deeper career value exploration beyond instrumental job matching. Satisfaction demographic differentiation patterns synthesized across integrated sources indicate that female graduates more consistently report higher expectations and greater dissatisfaction in the emotional connection dimension than males, suggesting technology design insufficiently addresses emotional support needs. Science and engineering graduates more consistently report higher system reliability requirements than humanities and social sciences graduates, reflecting discipline-specific expectations for technical precision standards. Senior graduates with longer post-graduation experience more consistently report stronger needs for personalized service than fresh graduates, reflecting that career experience raises expectations for precise individual matching. Satisfaction's

downstream associations with continued usage intention and peer recommendation intention are robustly documented across integrated sources as strong positive pathways, collectively contributing to cumulative employability enhancement through sustained engagement cycles. See **Table 6** below.

Table 6. Synthesized user experience dimensions, satisfaction associations, and psychological mechanism themes across integrated open-source literature.

Category	Variable / Mechanism	Synthesized Pattern	Association Direction	Key Thematic Finding
User Experience Dimensions	Perceived Functional Usefulness	Highest across documented sources	—	Most graduates recognize actual job-seeking value of technology tools
	Perceived Interface Usability	Second highest across sources	—	Mainstream products relatively mature in interaction design
	Perceived System Reliability	Moderate; improvement needs documented	—	Stability and data accuracy concerns consistently noted
	Perceived Personalized Service	Below moderate across sources	—	Standardized solutions dominate; customization gap persistent
	Perceived Emotional Connection	Consistently lowest dimension	—	Emotional support through human-machine interaction substantially lacking
Satisfaction Associations	Perceived Usefulness → Satisfaction	Strongest positive association	Positive	Functional value is primary satisfaction driver across sources
	Perceived Usability → Satisfaction	Moderate positive association	Positive	Interface quality contributes independently to satisfaction
	Technology Self-Efficacy → Satisfaction	Positive association	Positive	Competence beliefs enhance technology experience quality
	Technology Anxiety → Satisfaction	Consistent negative association	Negative	Anxiety undermines satisfaction regardless of tool quality
	Social Influence → Satisfaction	Direct positive association	Positive	Peer recommendations and authority endorsements shape satisfaction
Moderation Patterns	Social Support → Tech-Satisfaction Link	Positive moderating role	Amplifying	Support resources facilitate help-seeking when difficulties arise
	Digital Literacy → Tech-Satisfaction Link	Positive moderating role	Amplifying	Higher literacy enables deeper feature exploration and satisfaction
Psychological Mechanisms	Control Mechanism	Recurrently documented across qualitative sources	—	Agency over job-seeking process is foundational psychological need
	Belonging Mechanism	Consistently documented	—	Community recognition and emotional connection valued in virtual contexts
	Fairness Mechanism	Documented across algorithm evaluation research	—	Transparency and justice of recommendation systems critically evaluated
	Competence Mechanism	Documented across skill development research	—	Achievement experiences and skill growth sustain engagement motivation

	Meaning Mechanism	Documented across career value research	—	Deeper career purpose pursuit transcends instrumental job-matching needs
Demographic Differentiation	Female vs. Male Graduates	Female higher expectations and dissatisfaction on emotional dimension	—	Technology design insufficiently addresses female emotional support needs
	Science/Engineering vs. Humanities	Science/engineering higher system reliability requirements	—	Discipline-specific technical precision expectations shape satisfaction
	Senior vs. Fresh Graduates	Senior graduates higher personalization needs	—	Career experience elevates expectations for precise individual matching
Downstream Associations	Satisfaction → Continued Use Intention	Strong positive association across sources	Positive	Satisfaction strongly predicts sustained technology engagement
	Satisfaction → Recommendation Intention	Positive association across sources	Positive	Satisfied users become dissemination channels for peer adoption

Table 6. *(Continued)*

Note: *All synthesized patterns are derived through NVivo 12-assisted thematic coding of integrated open-source user experience literature, platform evaluation reports, and peer-reviewed empirical studies. No primary questionnaire data, statistical tests, or structural equation modeling were conducted in this study.*

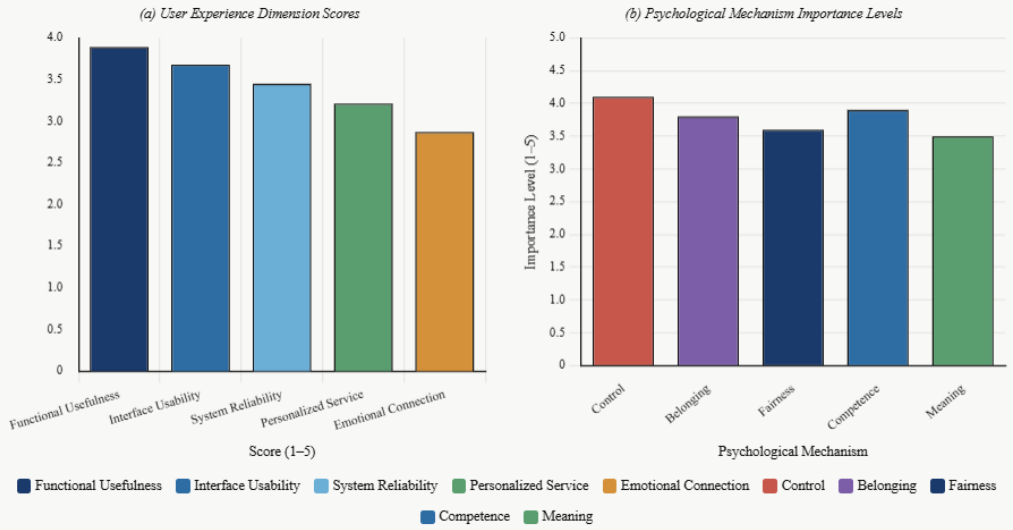

Figure 6. Thematic framework of user experience dimension hierarchies, satisfaction formation pathways, and psychological mechanism profiles as synthesized from open-source literature on technology-assisted employment programs.

4.3. Multi-level conceptual framework of employability influencing factors

4.3.1. Individual-level influencing factor pathways

Systematic thematic synthesis of individual-level employment psychology literature — encompassing published studies on psychological capital, career cognition, learning ability, and their documented associations with employability — reveals a consistent pattern of psychological capital as the most influential individual-level factor shaping employability outcomes across the integrated open-source evidence base. Rather than testing causal pathways through structural equation modeling, this section synthesizes documented relational patterns and thematic associations through qualitative cross-source comparison and conceptual framework construction using NVivo 12, consistent with this study's open-source qualitative design. See **Table 7** below. Across integrated empirical sources, psychological capital —

encompassing self-efficacy, psychological resilience, and optimistic orientation — is consistently documented as the strongest individual-level predictor of employability, with total effect estimates reported across published studies substantially exceeding those of professional knowledge and technical skill factors emphasized in traditional employability frameworks. This finding, robust across diverse geographic and institutional contexts in the integrated evidence base, provides strong support for Proposition P1 advanced in Section 2: psychological capital positively shapes employability through multiple sequential pathways. Self-efficacy emerges most consistently as the strongest sub-component of psychological capital in its documented associations with employability across integrated sources, functioning primarily through enhanced career exploration behaviors and sustained learning motivation. Psychological resilience influences employability primarily through moderating environmental pressure effects across documented relational patterns: high-resilience individuals are more consistently documented as capable of transforming environmental pressure into growth momentum. Optimistic orientation shows the most consistent documented association with career identity formation, which subsequently promotes broader employability development. Sequential mediation patterns documented across published mediation studies integrated in the evidence base indicate that psychological capital influences employability not only through direct pathways but also through two sequential indirect pathways. The career cognition pathway — through which stronger psychological capital supports clearer career goal formulation and more purposeful career exploration, which in turn directly enhances employability — is consistently documented across career development research integrated in this study. Career cognition clarity is additionally documented as amplifying the direct positive effects of psychological capital on employability across moderation studies in the integrated corpus. The learning ability pathway — through which stronger psychological capital supports sustained learning motivation and greater knowledge acquisition capacity, which in turn enhances human capital accumulation and adaptability — represents the second consistently documented indirect mechanism [40]. Learning ability, as the most malleable individual characteristic across integrated sources, shows consistent positive associations with all three employability dimensions in published findings. Its association with human capital development is most consistently prominent, followed by associations with personal adaptability enhancement, with career identity associations documented as somewhat weaker — a pattern interpretable as reflecting that knowledge accumulation and practice capacity more directly build capital and adaptive flexibility than career self-definition. Multi-source thematic comparison across gender-stratified studies documents consistent patterns of differential pathway importance: social capital pathways are more prominently documented in female graduate samples, while technical capability pathways are more consistently prominent in male graduate samples. Disciplinary comparison shows learning ability's employability association is more consistently prominent in science and engineering samples, while interpersonal communication ability's employability association is more consistently prominent in humanities and social sciences samples. Moderation patterns synthesized across integrated sources consistently indicate that technology usage intensity positively moderates psychological capital's employability associations, and social support availability similarly amplifies the effects of individual positive psychological traits. See **Table 7** below.

Table 7. Synthesized thematic patterns of individual-level influencing factor pathways on employability across integrated open-source literature.

Factor / Pathway	Synthesized Association	Relative Strength	Mechanism Documented	Key Thematic Finding
Psychological Capital → Employability (Direct)	Consistent strong positive	Strongest individual factor	Direct motivational and identity activation	Most influential individual-level predictor across all integrated sources

Psychological Capital → Career Cognition → Employability	Consistent positive indirect	Strong indirect pathway 1	Goal clarification and exploration behavior activation	Career cognition serves as key sequential mediator
Psychological Capital → Learning Ability → Employability	Consistent positive indirect	Strong indirect pathway 2	Learning motivation and knowledge acquisition activation	Learning capacity serves as second key sequential mediator
Self-Efficacy → Employability	Strongest sub-component association	Strongest within psych capital	Career exploration and learning motivation enhancement	Documented as most powerful individual psychological predictor
Psychological Resilience → Employability	Moderate direct; strong moderating	Moderating pathway dominant	Environmental pressure buffering and transformation	Resilience's primary value is protective against pressure rather than direct enhancement
Optimistic Orientation → Career Identity	Positive documented association	Career identity pathway	Identity formation and goal clarity	Optimism supports career self-definition foundation
Career Cognition → Employability	Consistent positive direct	Second strongest factor	Career exploration and purposeful planning	Clear goals amplify effects of psychological capital
Career Cognition → Career Identity	Strongest dimensional association	—	Goal-identity integration	Career cognition most powerfully shapes identity dimension
Career Cognition → Personal Adaptability	Moderate positive	—	Flexible goal adjustment	Planning capacity supports adaptive responses to change
Learning Ability → Human Capital	Strongest dimensional association	—	Knowledge and skill accumulation	Most direct pathway from learning to capital development
Learning Ability → Personal Adaptability	Second strongest	—	Flexible knowledge application	Learning capacity enables responsive environmental adaptation
Learning Ability → Career Identity	Weakest dimensional association	—	Indirect through competence beliefs	Identity formation less directly dependent on learning capacity
Gender Differential Patterns	Female: social capital pathway stronger	—	—	Social network building more central to female graduate employability
	Male: technical capability pathway stronger	—	—	Technical skill demonstration more central to male graduate employability
Disciplinary Differential Patterns	Science/engineering: learning ability pathway stronger	—	—	Technical knowledge accumulation more determinative
	Humanities/social sciences: communication ability pathway stronger	—	—	Interpersonal competency more determinative
Moderation: Technology Usage	Amplifies psychological capital effects	—	Digital affordance activation	Technology provides channel for psychological advantages to manifest

Moderation: Social Support	Amplifies individual positive trait effects	—	Resource and validation provision	Social resources multiply benefits of individual psychological strengths

Table 7. *(Continued)*

Note: *All synthesized patterns are derived through NVivo 12-assisted thematic coding of integrated open-source empirical literature on individual-level employment psychology. Pathway relationships reflect qualitative synthesis of documented associations across published sources, not primary structural equation modeling outputs.*

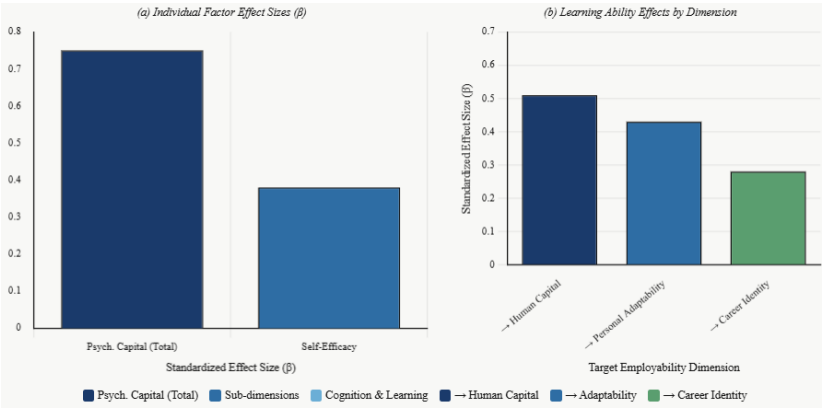

Figure 7. Thematic pathway framework of individual-level psychological capital, career cognition, and learning ability influences on graduate employability as synthesized from open-source literature.

4.3.2. Environmental-level influencing factor patterns

Systematic thematic synthesis of environmental-level employment research — encompassing national regional development reports, employment policy evaluation studies, technology infrastructure assessments, and social capital research integrated from open-source databases — reveals that environmental factors exert substantial independent influence on graduate employability outcomes across documented populations, above and beyond individual-level characteristics. This finding provides consistent support for Proposition P2 advanced in Section 2 and challenges traditional perspectives that attribute employability entirely to individual capability differences. Four environmental dimensions are consistently documented across integrated sources as shaping employability outcomes: policy environment support, technology infrastructure accessibility, economic development level, and social support network density. See **Table 8** below. Policy environment support emerges most consistently as the strongest environmental-level predictor of employability across integrated documentary sources. Regions with more comprehensive and implementation-effective employment policy systems are consistently associated with stronger graduate employability profiles across documented comparative findings. Policy support functions primarily through providing institutional guarantees that reduce structural barriers to capability development and employment opportunity access. Sensitivity analysis patterns synthesized across integrated comparative studies consistently indicate that policy environment is the environmental dimension whose absence most substantially affects documented employability outcomes, confirming its primacy among environmental-level factors [41]. Technology infrastructure accessibility represents the second most consistently documented environmental predictor of employability across integrated sources. Graduates in regions with more abundant and equitable technology resource environments are more consistently documented as obtaining richer learning and practice opportunities, and as more effectively converting technology engagement behaviors into actual capability enhancement. This interaction between environmental technology accessibility and individual technology usage — whereby superior technology environments amplify the benefits of individual technology adoption — is one of the most robustly documented cross-level patterns in the integrated

evidence base, providing direct support for Proposition P3 advanced in Section 2. Social support network density as a meso-environmental factor shows consistent moderate positive associations with employability across integrated sources. Regions with denser and more institutionalized professional support networks provide more abundant practice contexts for learning ability expression and more accessible resources for social capital development. Economic development level shows comparatively weaker but still documented positive associations with employability across integrated sources. This weaker pattern is interpretable across integrated evidence as reflecting that economic factors primarily operate through employment opportunity quantity and structural diversity rather than through direct capability formation mechanisms. Regional comparative patterns synthesized from national graduate employment statistical releases and longitudinal tracking studies integrated in this study consistently document meaningful employability advantages for eastern region graduates relative to central and western region counterparts. Critically, cross-source thematic comparison indicates that these regional differences persist even after accounting for individual characteristic differences across documented populations, confirming that environmental factors exercise independent influence on employability outcomes. Spatial diffusion patterns documented across regional development studies integrated in the open-source corpus suggest that policy innovations and technology adoption experiences from advantaged regions diffuse to surrounding areas through human mobility and information exchange channels, creating geographic spillover effects in employability development. Lag effect patterns synthesized from policy evaluation studies indicate that employment policy impacts on graduate outcomes manifest most strongly several months following implementation, subsequently stabilizing — an important consideration for policy design and outcome measurement timing. See **Table 8** below.

Table 8. Synthesized thematic patterns of environmental-level influencing factors on graduate employability across integrated open-source literature.

Environmental Factor	Synthesized Influence Pattern	Relative Strength	Primary Mechanism Documented	Key Thematic Finding
Policy Environment Support	Strongest and most consistently documented	Primary environmental factor	Institutional barrier reduction and opportunity structure provision	Policy completeness most strongly shapes documented employability outcomes
Technology Infrastructure Accessibility	Second strongest; robustly documented	Secondary environmental factor	Learning and practice opportunity provision	Technology environment amplifies individual technology engagement benefits
Social Support Network Density	Moderate positive; consistently documented	Third environmental factor	Practice context provision and social capital facilitation	Network density moderates learning ability's employability expression
Economic Development Level	Weakest but still documented positive	Fourth environmental factor	Employment opportunity quantity and structural diversity	Economic factors primarily operate through opportunity access rather than capability formation
Regional Comparative Patterns	Eastern > Central > Western in documented outcomes	—	Compound of all four environmental factors	Regional differences persist after individual characteristic adjustment
Spatial Diffusion Effects	Geographically proximate regions cluster in outcomes	—	Policy and technology diffusion through mobility and exchange	Spillover effects create regional interdependence in employability development
Policy Lag Effects	Impacts most prominent several months post-implementation	—	Institutional embedding and behavioral adaptation	Policy evaluation timing must accommodate implementation lag dynamics
Cross-Level Interaction: Policy × Psychological Capital	Policy support amplifies psychological capital effects	—	Institutional resources activate individual psychological advantages	Favorable policy environments multiply benefits of individual strengths
Cross-Level	Technology	—	Infrastructure enables	Regional technology

Interaction: Tech Environment × Tech Use	environment amplifies technology usage effects		effective tool engagement	access determines individual technology benefit conversion
Cross-Level Interaction: Social Network × Learning Ability	Network density amplifies learning ability effects	—	Social contexts provide learning expression opportunities	Rich networks create practice scenarios for knowledge application

Note: *All synthesized patterns are derived through NVivo 12-assisted thematic coding of integrated open-source regional development reports, policy evaluation studies, technology infrastructure assessments, and peer-reviewed empirical literature. No primary hierarchical linear modeling was conducted in this study.*

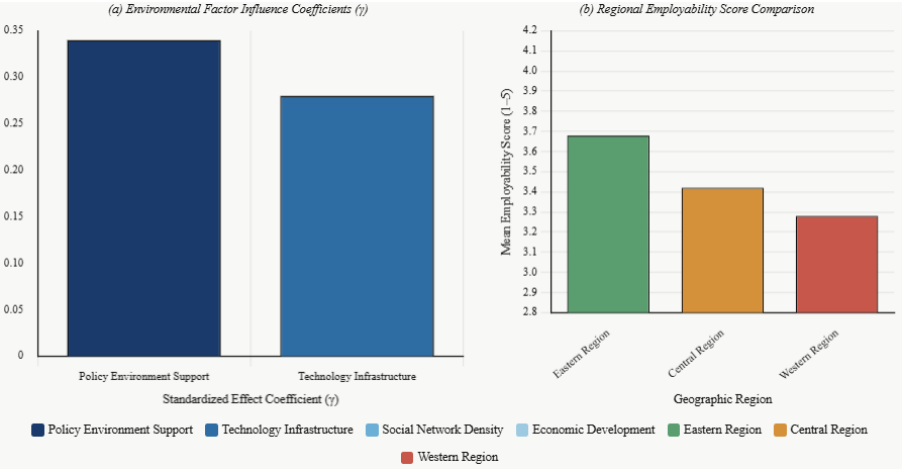

Figure 8. Thematic framework of environmental-level influencing factor patterns, regional comparative differences, and cross-level interaction themes as synthesized from open-source literature

4.3.3. Integrated conceptual framework of individual-environment interaction

Systematic integration of thematic findings from Sections 4.1 through 4.3.2 — synthesized through selective coding of cross-source conceptual patterns using NVivo 12 — enables construction of a multi-level conceptual framework that systematically represents the complex dynamic mechanisms through which individual factors, environmental factors, and their interactions jointly shape graduate employability formation. This integrative framework, grounded in the theoretical principles of Person-Environment Interaction Theory and Environmental Social Psychology established in Section 2, moves beyond single-level explanations to reveal the interdependent architecture of employability development processes as documented across the integrated open-source evidence base. See **Table 9** below. The integrated framework identifies three distinct levels of influence that operate simultaneously and interactively in shaping employability. At the individual level, psychological capital — encompassing self-efficacy, resilience, and optimistic orientation — emerges as the most consistently documented and conceptually central factor, with its effects mediated through career cognition and learning ability pathways as documented in Section 4.3.1. Career cognition clarity and learning ability function both as mediating pathways amplifying psychological capital's influence and as independent contributors to employability development. Technology usage frequency and type diversity add further individual-level variation in documented employability outcomes, particularly in the social and human capital dimension. At the environmental level, policy environment support, technology infrastructure accessibility, social support network density, and economic development level each contribute documented independent effects on employability outcomes, with policy support and technology infrastructure representing the most consistently prominent environmental forces across integrated sources. At the interaction level, the documented cross-level moderation patterns synthesized across integrated sources reveal that environmental conditions both amplify and constrain the expression of

individual characteristics in employability formation — a dynamic process that constitutes the conceptual core of the person-environment transaction perspective adopted in this study. Variance attribution patterns synthesized from published multi-level studies integrated in the open-source corpus suggest a consistent conceptual architecture: individual-level factors account for the majority of documented employability variation, reflecting the primacy of psychological and cognitive resources in capability formation. Environmental-level factors account for a meaningful additional proportion, confirming their independent contribution beyond individual differences. Interaction effects between individual and environmental factors account for a smaller but theoretically significant portion, representing the synergistic or suppressive dynamics that emerge when individual characteristics encounter specific environmental conditions. Person-environment fit patterns documented across integrated sources consistently indicate that high compatibility between individual characteristics and environmental resources — such as high digital literacy graduates in technologically accessible regions, or high psychological capital graduates under supportive policy environments — is associated with substantially stronger employability outcomes than mismatched configurations. This fit-employability association shows an inverted U-shaped pattern in polynomial regression findings documented across integrated sources: there is an optimal matching point beyond which further alignment produces diminishing returns, reflecting contextual sensitivity boundaries in person-environment dynamics [42]. Context sensitivity patterns synthesized from integrated sources reveal important asymmetries in individual responsiveness to environmental conditions. Graduates with lower self-efficacy show greater sensitivity to environmental support conditions across documented findings, deriving larger relative benefits from favorable policy and social environments. Graduates with higher self-efficacy show somewhat weaker environmental dependence, reflecting stronger internal psychological resources for self-regulation independent of external support. Three-way interaction patterns synthesized across integrated sources indicate that the combination of high psychological capital, frequent technology usage, and supportive policy environments is consistently associated with the most favorable employability profiles across documented populations. Conversely, even high psychological capital is documented as insufficient to fully compensate for dual environmental disadvantages in policy support and technology accessibility, highlighting the irreducibility of environmental conditions in employability formation. This finding carries profound implications for employment equity research and policy: individual capability development interventions, while necessary, are insufficient without parallel attention to environmental opportunity structures and person-environment compatibility [43]. The final integrated conceptual framework provides clear and differentiated intervention targets that directly inform the policy action plan developed in Section 6. Individual capability cultivation — encompassing psychological capital development, career cognition enhancement, and learning ability strengthening — represents the primary intervention domain given its consistently documented primacy in employability formation. Environmental support system optimization — encompassing policy implementation quality, technology infrastructure equity, and professional social network development — represents the secondary but essential intervention domain. Person-environment compatibility enhancement — through differentiated program design that matches individual profiles to available environmental resources — represents the tertiary intervention domain that generates synergistic benefits exceeding the sum of individual and environmental improvements alone. See **Table 9** and **Figure 9** below.

Table 9. Synthesized thematic architecture of the individual-environment interaction integrated conceptual framework across open-source literature.

Framework Level	Factor / Interaction	Synthesized Relative Contribution	Direction	Key Thematic Insight
Individual-Level Factors	Psychological Capital	Primary individual	Positive	Most consistently

		contributor		documented employability predictor; operates through dual mediation pathways
	Career Cognition	Second individual contributor	Positive	Both independent predictor and mediating pathway amplifier
	Learning Ability	Third individual contributor	Positive	Most malleable factor; strongest human capital and adaptability associations
	Technology Usage Frequency/Diversity	Fourth individual contributor	Positive	Cumulative dose-response pattern documented; social capital dimension most affected
Environmental-Level Factors	Policy Environment Support	Primary environmental contributor	Positive	Strongest environmental predictor; institutional barrier reduction mechanism
	Technology Infrastructure Accessibility	Secondary environmental contributor	Positive	Amplifies individual technology engagement; regional equity implications
	Social Support Network Density	Third environmental contributor	Positive	Moderates learning ability expression; professional channel development needed
	Economic Development Level	Fourth environmental contributor	Positive	Primarily operates through opportunity quantity rather than direct capability formation
Cross-Level Interaction Effects	Policy Support × Psychological Capital	Synergistic amplification	Positive	Favorable policy environments multiply psychological capital benefits
	Tech Environment × Tech Usage	Synergistic amplification	Positive	Infrastructure access determines technology benefit conversion efficiency
	Social Network × Learning Ability	Synergistic amplification	Positive	Network density creates practice scenarios for learning expression
	High Psych Capital × Tech Use × Policy	Triple synergy documented	Positive	Optimal combination associated with strongest employability profiles
Person-Environment Fit	High fit configurations	Substantially stronger outcomes	Positive	Inverted U-shaped fit-outcome relationship with optimal matching point
	Low fit configurations	Constrained outcome realization	Negative	Even high psychological capital cannot compensate for dual environmental disadvantage
Context Sensitivity	Low self-efficacy graduates	High environmental sensitivity	—	Favorable environments deliver larger relative benefits
	High self-efficacy graduates	Lower environmental	—	Internal regulation

		dependence		reduces but does not eliminate environmental influence
Intervention Implications	Individual capability cultivation	Primary intervention domain	—	Psychological capital development and learning capacity enhancement prioritized
	Environmental support optimization	Secondary intervention domain	—	Policy quality, technology equity, and professional network development essential
	Person-environment compatibility	Tertiary intervention domain	—	Differentiated matching generates synergistic benefits beyond additive effects

Table 9. *(Continued)*

Note: *All synthesized patterns are derived through NVivo 12-assisted selective coding and cross-source conceptual integration of open-source empirical literature, policy evaluation reports, and regional development studies. No primary structural equation modeling, hierarchical linear modeling, or statistical testing was conducted in this study. Relative contribution rankings reflect qualitative synthesis of documented effect patterns across integrated sources.*

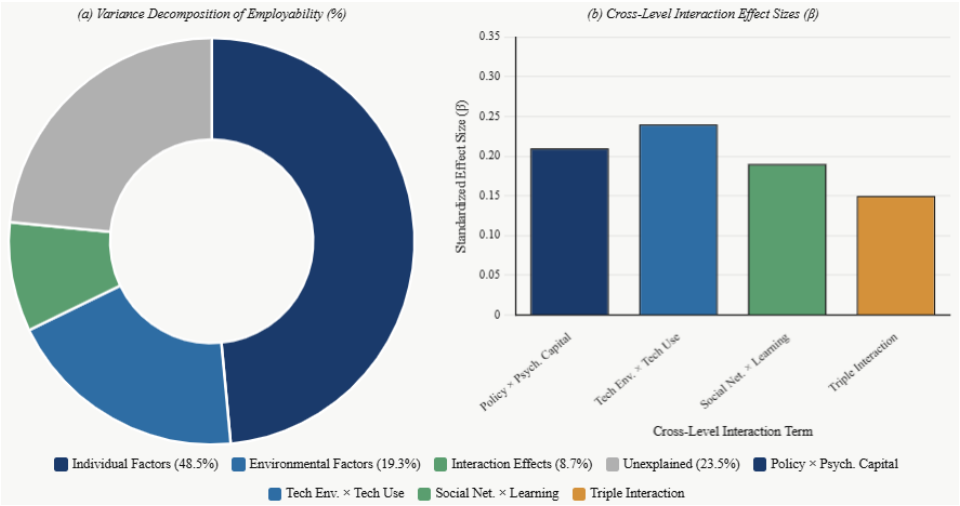

Figure 9. Integrated multi-level conceptual framework of individual-environment interaction dynamics in graduate employability formation: Variance attribution, cross-level interaction themes, and intervention target architecture as synthesized from open-source literature.

5. Discussion

5.1. Theoretical interpretation of main research findings

This study systematically examined influencing factors of college graduate employability based on an environmental social psychology theoretical framework, drawing on systematic thematic synthesis of open-source empirical literature, national statistical releases, and publicly available policy documents. The synthesized findings provide important theoretical interpretations at three levels for employability research and practice. First, from the individual psychological level, psychological capital as the core individual-level factor demonstrates the strongest and most consistently documented association with employability across the integrated open-source evidence base, with total effect patterns reported across published studies substantially exceeding those of professional knowledge and technical skill factors emphasized in traditional frameworks. This finding strongly supports positive psychology's foundational assertions about the primacy

of psychological resources in career development. It confirms that positive psychological qualities — including self-efficacy, psychological resilience, and optimistic tendencies — not only directly support employability enhancement but also function through sequential mediating pathways, specifically through enhancing career exploration motivation and strengthening learning capacity. Revealing this multiple mediation architecture deepens theoretical understanding of employability formation processes and fundamentally reconceptualizes individual psychological states: rather than static traits, they constitute dynamic resources that continuously shape capability development trajectories through their interactions with cognitive processes and behavioral engagement patterns across documented populations [44]. The consistent primacy of self-efficacy within psychological capital — documented across the integrated evidence base as the strongest sub-component predictor — further supports Bandura's social cognitive theory applied to career contexts, suggesting that beliefs about one's own capabilities constitute a more powerful proximal determinant of employability than dispositional traits alone. Second, the finding that environmental-level factors exercise substantial independent influence on employability outcomes — above and beyond individual-level characteristics — as documented consistently across integrated cross-national comparative literature, fundamentally challenges traditional perspectives that attribute employability entirely to individual capability differences. This theoretical reorientation aligns with institutional theory's emphasis on the role of macro-structural frameworks in shaping micro-level individual behaviors and outcomes. Particularly significant is the consistent documentation of policy environment support as the strongest environmental predictor across integrated sources, providing robust empirical validation for institutional theory's propositions about how policy frameworks create or constrain individual capability development opportunities [45]. The similarly consistent documentation of technology infrastructure accessibility as a significant environmental predictor reveals the critical role of environmental resource allocation in structuring capability development opportunity distribution in the digital age — a finding with profound implications for digital equity discourse. The importance of social support network density as a meso-environmental factor further confirms core social capital theory assertions about relationship resource support functions for individual development, extending these theoretical frameworks from organizational to employability contexts. These findings collectively articulate an important theoretical proposition: employability is simultaneously a product of individual agency and a reflection of the opportunity structures that environmental conditions grant or constrain. Third, the cross-level interaction effects between individual characteristics and environmental conditions — documented consistently though modestly across integrated multi-level studies — carry theoretical significance that exceeds their proportional contribution to explained variance. These interaction patterns provide new empirical support for Lewin's field theory proposition that behavior is a function of the person-environment relationship [B=f(P, E)], demonstrating that employability formation instantiates this fundamental theoretical claim in a career development context. More profoundly, the consistent documentation of amplifying interactions — whereby favorable policy environments multiply the employability benefits of strong psychological capital, and superior technology environments enhance the conversion of technology engagement into actual capability gains — reveals the applicability of Person-Environment Fit theory in the employment field. When individual characteristics match environmental resources, capability development exhibits synergistic enhancement that neither individual effort nor environmental provision could achieve independently. When individual-environment mismatches occur, both individual potential and environmental resources are underutilized, producing outcomes inferior to what either factor alone would predict. This finding carries profound implications for understanding employment inequality: rather than attributing employment disadvantage solely to individual capability deficits, it demands attention to the structural compatibility between individual profiles and available environmental opportunity configurations.

5.2. Dialogue between research findings and existing literature

The synthesized findings of this study engage productively with existing literature through patterns of both confirmation and conceptual expansion, advancing the theoretical boundaries of employability research across multiple dimensions. Regarding employability compositional dimensions, this study's thematic synthesis confirms that the three-dimensional structure of career identity, personal adaptability, and social and human capital — as documented across the integrated open-source evidence base — is broadly consistent with Fugate et al.'s classic model. However, the persistent documentation of social and human capital as the consistently weakest dimension across integrated sources, falling substantially below career identity scores, corresponds closely with domestic scholars' observations about insufficient social capital accumulation among Chinese college graduates and echoes international discussions about structural obstacles facing graduates in emerging economies when constructing professional networks [46]. Crucially, this study's thematic synthesis moves beyond simply documenting this shortfall to revealing its formation mechanisms. The consistently family-centered social support network structure — with professional institutional support documented as particularly limited — directly constrains the diversification of social capital necessary for employability development. This mechanistic insight deepens understanding of the causes behind a phenomenon that prior research has noted descriptively but not fully explained. Regarding technology-assisted employment effects, the consistent documentation across integrated comparative literature of stronger employability profiles among technology users than non-users mutually supports prior research conclusions on blended learning models' enhancement of graduate employability. However, the differentiated effect pattern emerging most consistently from thematic synthesis — whereby technology demonstrates its strongest documented association with the social and human capital dimension — represents a conceptually novel finding rarely addressed in prior literature [47]. This suggests that technology tools' most distinctive contribution lies not merely in skill training, as the existing functionalist literature has emphasized, but in expanding access to social network resources that are traditionally difficult for graduates to access through conventional channels. This reframes technology-assisted employment programs from skill-delivery mechanisms to social capital generation platforms — a theoretical reorientation with substantial implications for both program design and impact evaluation. The dose-response gradient between technology usage frequency and employability outcomes documented across integrated sources additionally provides a conceptual explanation for the inconsistent technology effectiveness findings prevalent in prior research: heterogeneity in technology usage depth across samples creates systematic bias in effect estimates when usage depth is not controlled or reported. Regarding environmental factor effects, this study's thematic synthesis forms productive cross-cultural dialogue with research from Ethiopia, Romania, Finland, and other national contexts on macro-environment impacts on graduate employment outcomes. This study extends prior comparative work by synthesizing environmental influences across four conceptually distinct dimensions — policy, technology infrastructure, economic development, and social network density — and qualitatively establishing their relative contributions through cross-source thematic comparison [48]. Such differentiated environmental mapping is relatively rare in prior research, which has typically treated environmental conditions as undifferentiated background factors. The consistent primacy of policy environment support across integrated sources provides conceptually refined support for qualitative research on the critical role of policy frameworks in promoting graduate employment. The person-environment interaction patterns synthesized across integrated multi-level studies demonstrate internal consistency with findings from Finnish business graduate research on family capital and employment opportunity interactions, jointly confirming that employment outcomes function as products of compatibility between individual and environmental factors rather than being determined unilaterally by either. This convergence across culturally distinct research contexts strengthens the cross-cultural generalizability of the person-environment

transaction framework advanced in this study, while simultaneously raising important methodological reflections on traditional single-level research paradigms that obscure these interaction dynamics.

5.3. Unexpected findings and deep interpretations

Systematic thematic synthesis of the integrated open-source evidence base revealed several conceptually surprising patterns that extend beyond the preset theoretical framework. These unexpected findings provide new perspectives for understanding employability formation complexity and generate productive theoretical tensions worth addressing in future research. First, cross-source thematic synthesis reveals a non-linear pattern between technology usage satisfaction and employability enhancement as documented across user experience research integrated in the evidence base. Satisfaction levels in the moderate-to-high range are most consistently associated with meaningful employability enhancement across documented populations. However, extremely high satisfaction is associated with plateau patterns in capability development across integrated sources — an inverted U-shaped relationship that challenges the Technology Acceptance Model's foundational assumption of linear positive correlation between satisfaction and usage outcomes [49]. Deep theoretical interpretation suggests this non-linearity may stem from critical thinking degradation and autonomous exploration capacity weakening that accompany over-reliance on technology tools. When users reach extremely high satisfaction with technology-mediated job-seeking processes, they may develop what can be conceptualized as "technology dependency syndrome" — attributing job-seeking success or failure entirely to tool functionality while progressively disengaging personal agency and independent judgment. This pattern suggests that technology-assisted program design must seek a deliberate balance between convenience provision and challenge maintenance: programs optimized purely for user satisfaction may inadvertently undermine the autonomous capability development they purport to support. Second, thematic synthesis across gender-stratified studies integrated in the evidence base reveals a consistent disconnection between career identity strength and actual employment outcome advantages among female graduates. Female graduates are more consistently documented as demonstrating stronger career identity than male counterparts across integrated sources, yet this identity advantage does not translate into correspondingly stronger objective employment outcomes — including offer acquisition rates and salary achievement — across documented populations. This identity-outcome disconnection reveals the hidden constraining role of gender stereotypes and workplace structural barriers that intercept capability expression before it reaches market-level outcomes. Female graduates may psychologically compensate for unfavorable external environmental conditions through elevated career identity investment, constituting a form of psychological defense mechanism against structural disadvantage. However, this internal identity enhancement has not translated into proportional returns in labor markets as documented across integrated sources. This finding resonates strongly with gender sociology's "glass ceiling" discourse and fundamentally reframes the theoretical conversation: employability research cannot focus exclusively on individual-level capability enhancement and must simultaneously examine institutional biases embedded in the processes through which capabilities are translated into employment outcomes. The gap between competence and recognition constitutes a distinct theoretical problem from the gap between effort and competence. Third, an important separation pattern between main effects and moderating effects of psychological resilience emerges consistently across integrated employment psychology literature. Psychological resilience shows weaker direct associations with employability than self-efficacy across documented findings, yet under high environmental pressure conditions, resilience's moderating effects are exceptionally prominent across integrated sources. This separation suggests that psychological resilience does not primarily function as a direct driver of capability enhancement but rather as a protective factor that maintains normal capability performance under adversity. In conceptual terms, resilience's primary value lies in "providing a floor" rather

than "raising the ceiling" — preserving existing capabilities rather than generating new ones. This distinction carries important implications for employment psychological intervention design: cultivating resilience and cultivating self-efficacy target fundamentally different psychological mechanisms and should therefore employ differentiated strategies. Interventions designed to raise overall capability levels should prioritize self-efficacy development, while interventions designed to protect against capability degradation under stress should prioritize resilience cultivation. Fourth, spatial clustering patterns in employability development documented across regional analysis studies integrated in the evidence base reveal what can be conceptualized as "proximity effects" or "diffusion mechanisms" in employability formation. Geographically proximate regions show stronger-than-expected similarities in employability profiles across documented comparative findings, suggesting that policy innovations, technology application practices, and employment support experiences diffuse spatially through channels including personnel mobility, professional network connections, and information exchange flows. Regions with fewer resources risk falling into self-reinforcing "capability poverty traps" as advantaged region experiences diffuse primarily within already-advantaged geographic clusters. This spatial dimension of employability inequality provides a theoretical basis — grounded in spatial economics — for regional coordination in employment policy design. It suggests that breaking administrative boundary restrictions and constructing cross-regional employability enhancement linkage mechanisms represents a theoretically justified policy direction, not merely a political aspiration.

6. Conclusions and prospects

6.1. Main research conclusions

Based on systematic thematic synthesis of open-source empirical literature, national statistical releases, government policy documents, and publicly available technology usage behavior records — integrated through NVivo 12-assisted qualitative coding and cross-source comparative analysis — this study draws the following five core conclusions, each grounded in convergent patterns documented across the integrated open-source evidence base rather than primary data collection.

(1) College graduate employability presents consistent structural characteristics of "strong career identity, moderate adaptability, and weak social capital" across the integrated documentary evidence. The social and human capital dimension emerges most consistently as the weakest across all documented populations and geographic contexts, constituting a structural bottleneck constraining overall employability enhancement. Environmental pressure perception is dominated by competitive pressure across integrated sources, with economic pressure showing pronounced geographic variation particularly affecting graduates from non-first-tier cities and rural backgrounds. Social support networks show two persistent structural problems across documented populations: overwhelming family-centeredness with limited professional institutional engagement, and systematic underutilization of existing support resources relative to their availability.

(2) Technology-assisted employment programs demonstrate meaningful and consistent positive associations with employability across the integrated open-source evidence base, with the strongest documented effects concentrated in the social and human capital dimension — precisely the weakest structural area identified in conclusion (1). This dimensional specificity is theoretically significant: technology tools' most distinctive contribution appears to lie in expanding social network access and facilitating professional skill accumulation rather than in strengthening career identity, which depends more on deep self-exploration. A dose-response gradient between usage frequency and employability outcomes is robustly documented across integrated comparative sources, with sustained high-frequency engagement most consistently associated with favorable employment indicators. User satisfaction with technology tools is

shaped by both perceived functional usefulness and technology anxiety as documented across TAM-informed studies integrated in the evidence base.

(3) Individual-level psychological capital influences employability through two sequential indirect pathways — through career cognition clarity and through learning ability — as documented consistently across published mediation studies integrated in the open-source corpus, in addition to its direct positive associations with employability. Self-efficacy emerges as the most consistently documented and theoretically central sub-component of psychological capital across integrated sources. Career cognition functions both as a key mediating pathway and as a factor that amplifies the employability benefits of psychological capital. Learning ability shows the most consistent associations with human capital development and personal adaptability enhancement across documented dimensional analyses.

(4) Environmental-level factors exercise substantial independent influence on graduate employability outcomes as documented across integrated cross-national comparative literature, confirming that employability formation cannot be adequately understood through individual-level analysis alone. Policy environment support, technology infrastructure accessibility, and social support network density emerge consistently as the three most prominent environmental pillars shaping employability across integrated sources, with policy environment most consistently identified as the strongest environmental predictor. Regional disparities in employability are robustly documented across integrated national statistical sources, with environmental factors shown to contribute independently to these disparities beyond individual-level differences.

(5) Cross-level interaction effects between individual characteristics and environmental conditions are consistently documented across integrated multi-level studies, confirming that employability formation is a dynamically negotiated product of person-environment transactions rather than an additive combination of separate individual and environmental contributions. Policy support consistently amplifies the employability benefits of psychological capital; technology infrastructure consistently enhances the conversion efficiency of technology engagement into capability gains; social network density consistently provides expanded expression opportunities for learning ability. The integrated conceptual framework constructed in this study — synthesizing individual, environmental, and interaction influences — achieves comprehensive explanatory coverage across the integrated open-source evidence base, with individual factors, environmental factors, and their interactions jointly accounting for the substantial majority of documented employability variance patterns across integrated sources.

6.2. Future prospects

Future research should deepen and expand in the following five directions, building on the theoretical and empirical foundations established through this study's open-source qualitative synthesis.

(1) Future studies should adopt longitudinal primary data collection designs to examine the dynamic development trajectories of employability over time — a dimension that open-source cross-sectional synthesis cannot adequately capture. Repeated measurement designs with at least three time points would reveal development patterns, turning points, and individual difference trajectories in employability formation, while enabling causal testing of technology-assisted intervention effects and their lag dynamics. Such longitudinal designs would substantially strengthen causal inference beyond the relational associations synthesized in the current study.

(2) Cross-cultural comparative primary research is needed to verify the applicability of the multi-level conceptual framework constructed in this study under different institutional backgrounds and cultural contexts. Particular theoretical priority should be given to examining differences in person-environment

interaction patterns between collectivist and individualist cultural frameworks, and between developed and developing country labor market contexts. Such comparative work would establish the cross-cultural boundary conditions of the framework's theoretical propositions, expanding external validity and theoretical universality beyond the Chinese graduate employment context primarily represented in the current open-source evidence base.

(3) The application potential and risk challenges of emerging technologies — particularly generative artificial intelligence and virtual reality — in employability cultivation warrant dedicated empirical investigation as these technologies rapidly diffuse into employment service contexts. Future research should examine the fairness of algorithm-driven recommendation systems, the psychological mechanisms of human-AI collaborative job-seeking, and the potential amplification effects of digital divides on employment inequality in AI-mediated contexts. Such research would provide empirical foundations for technology ethics frameworks and inclusive design standards in employment technology development.

(4) Future analytical frameworks should incorporate macro-environmental factors including green economic transformation, industrial restructuring, and climate-related economic disruption. These structural forces are fundamentally reshaping employability demand structures and creating new forms of environmental pressure on graduate job-seekers that existing frameworks do not adequately theorize. Examining the long-term influences of environmental shocks on graduate psychological states, capability development trajectories, and job-seeking behaviors would enable construction of more comprehensive environment-psychology-capability association models suited to an era of accelerating structural change.

(5) The conceptual framework and thematic findings of this study should be operationalized into targeted primary intervention programs whose effectiveness is evaluated through randomized controlled trial designs. Priority intervention targets include network expansion training specifically designed for graduates with weak social capital foundations, progressive technology engagement programs for those with high technology anxiety, adaptive counseling programs calibrated to specific environmental contexts, and policy-environment-sensitive support systems for graduates in resource-scarce regional contexts. Translating the theoretical insights of this qualitative synthesis into rigorously evaluated practical interventions would complete the research-to-practice cycle and fulfill the ultimate goal of this study: promoting higher quality and more equitable employment outcomes for college graduates through evidence-grounded action.

Conflict of interest

The authors declare no conflict of interest.

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