Research on Graduate Education Reform Based on the Reconstruction of Curriculum Design, Faculty Capacity and Educational Philosophy

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Abstract: Amid the national strategic emphasis on innovation-driven development, societal expectations for the innovation capacity and entrepreneurial mindset of high-level talent have intensified. Nevertheless, China's postgraduate education system faces persistent challenges in cultivating "innovation and entrepreneurship" competencies: (1) curricula remain fragmented and inadequately integrated with disciplinary knowledge; (2) faculty often lack hands-on entrepreneurial experience, and the prevailing single-advisor model proves insufficient to support students' heterogeneous developmental needs; and (3) students frequently exhibit a cognitive imbalance—prioritizing innovation while underestimating entrepreneurship. To address these systemic constraints, this paper proposes a holistic "four-pillar" reform framework grounded in the following interdependent principles: institutional mechanisms as the foundational enabler, curriculum design as the core driver, faculty development as the critical lever, and conceptual transformation as the ultimate objective. Drawing on root-cause analysis, the study articulates a tiered curriculum architecture comprising three progressive levels—foundational literacy, discipline-integrated application, and practice-oriented implementation. It further outlines a multifaceted faculty development strategy encompassing internal capacity building, external expertise recruitment, and cross-sectoral mentoring collaboration. Additionally, it advances a dual-track approach to student mindset cultivation—integrating values-based reorientation with immersive entrepreneurial culture. Finally, the paper offers concrete, actionable recommendations for policy reinforcement, resource allocation, and performance evaluation reform—intended to inform evidence-based advancement of postgraduate-level innovation and entrepreneurship education in China.

Keywords: Postgraduate Education; Innovation and Entrepreneurship Education; Curriculum Design; Faculty Capacity; Educational Philosophy

1. Introduction

Postgraduate education constitutes the primary arena for cultivating high-level talent in China and serves as a pivotal nexus where science and technology, human capital, and innovation converge [1]. In this context, developing postgraduate students who integrate rigorous disciplinary expertise with innovative thinking and entrepreneurial agency has become a strategic imperative for strengthening national competitiveness and advancing the construction of an innovation-driven nation [2]. By contrast, the traditional training paradigm—characterized by an overemphasis on knowledge transmission at the expense of competency development, and on theoretical research while marginalizing practice-oriented application—has grown increasingly misaligned with societal and economic demands for versatile, innovation-capable talent.

In recent years, numerous higher education institutions have initiated pilot initiatives in postgraduate innovation and entrepreneurship (I&E) education and reported preliminary progress [3]. Yet persistent structural impediments continue to constrain systemic effectiveness. First, I&E education is frequently positioned as a peripheral or supplementary component rather than an integral dimension of professional training, resulting in conceptual disjunction and curricular fragmentation for students. Second, dedicated I&E instructors often lack authentic industry engagement,

limiting their guidance to abstract principles [4]; conversely, academic supervisors—though deeply versed in disciplinary scholarship—typically possess limited experience in entrepreneurial mentoring, and the prevailing single-advisor model proves inadequate to support students' interdisciplinary learning trajectories and cross-sectoral developmental needs. Third, entrenched perceptions lead many postgraduate students to conflate "entrepreneurship" narrowly with venture creation (e.g., launching startups), overlooking its broader epistemic and pragmatic essence: a mindset and capability for identifying opportunities, mobilizing resources, and translating scholarly insights into tangible socioeconomic value. Consequently, student engagement with and commitment to entrepreneurship education remain comparatively low.

Grounded in this diagnostic analysis, this study advances a comprehensive reform framework anchored in four interrelated pillars: institutional safeguards, curriculum integration, faculty capacity enhancement, and conceptual reframing. It systematically addresses three core operational questions: (1) How can I&E curricula be coherently embedded within—and mutually reinforcing of—disciplinary programs? (2) How can faculty competencies in experiential mentoring be strengthened, and how can collaborative, multi-mentor guidance models be institutionalized? (3) How can students' instrumental understanding of entrepreneurship be transformed into a holistic, value-informed entrepreneurial identity? The proposed reform pathway is designed to be theoretically grounded, empirically informed, and practically implementable—aiming to foster the endogenous, quality-driven evolution of postgraduate I&E education and equip students with adaptive capabilities for complex, future-oriented challenges.

2. Current State and Problem Analysis of Postgraduate I&E Education

At present, graduate I&E education in China has entered the "deepening and breakthrough period" from the "initiation and exploration period". Although achievements are considerable, some deep-seated structural contradictions have become increasingly prominent, becoming a bottleneck restricting high-quality development.

2.1 Curriculum: Structural Imbalance Resulting in a Disconnect between Theory and Practice, and between Academic Learning and Real-World Application

2.1.1 Absence of strategic, coherent curriculum design—courses exhibit fragmentation and compartmentalization

Some universities implement I&E education in an ad hoc and decentralized manner, lacking a systematic, competency-based curriculum framework aligned with the developmental trajectory of postgraduate-level I&E capabilities, such as opportunity recognition, resource mobilization, risk assessment, and cross-disciplinary collaboration. Consequently, individual courses operate in isolation, with insufficient vertical progression or horizontal integration, thereby undermining pedagogical coherence and synergistic learning outcomes [5]. Furthermore, course offerings are predominantly supply-driven: institutions design curricula based on existing faculty expertise and institutional resources, rather than adopting a demand-driven approach grounded in postgraduate students' disciplinary contexts, research trajectories, and evolving industry requirements. As a result, course content often fails to resonate with students' academic specializations and hands-on research experiences, limiting both relevance and engagement [6].

For instance, at a leading engineering university, the I&E curriculum relies heavily on generic foundational courses—e.g., "Principles of Management" and "Marketing"—delivered by the college of Economics and Management. Notably absent are discipline-integrated, application-oriented courses that guide students in translating cutting-edge laboratory innovations—such as AI algorithm development or advanced material synthesis—into viable product prototypes or scalable business models responsive to authentic market needs.

2.1.2 Structural disjunction between disciplinary education and I&E education: integration remains symbolic rather than substantive

A persistent conceptual and operational divide exists between disciplinary faculties and I&E coordinating units. Many disciplinary faculty members perceive I&E education as peripheral or even extraneous to their core academic mission, expressing concerns that its integration may encroach upon dedicated time for disciplinary learning and compromise research

productivity. Compounding this challenge is the absence of robust institutional incentives: contributions to curriculum innovation—including the infusion of I&E competencies into foundational and advanced disciplinary courses—and mentorship in student-led ventures are seldom recognized in promotion criteria or workload allocation frameworks, rendering such efforts professionally unrewarding [7]. Consequently, "integration" frequently manifests only as perfunctory gestures. Crucially, I&E mindsets—such as design thinking, opportunity sensitivity, and value proposition development—remain absent from the epistemic scaffolding of disciplinary instruction, failing to permeate learning objectives, pedagogical strategies, or assessment practices across the curriculum [8].

2.1.3 Instrumentalization of practice: from authentic venture development to competition-centric "bonsai" projects

I&E practice is increasingly dominated by high-profile national competitions—such as the "Challenge Cup" and the "China Internet+ College Students I&E Competition"—leading to an instrumental orientation that prioritizes award-winning performance over authentic venture development. Faculty and students devote disproportionate effort to project "polishing" for competition submission, often at the expense of critical developmental activities: iterative prototyping, rigorous market validation, customer discovery, and sustainable operational planning. Consequently, a significant proportion of competition-winning projects are discontinued immediately after the finals—functioning as pedagogically limited "bonsai": aesthetically refined in controlled academic settings yet lacking resilience, scalability, or real-world viability. Institutional support for high-stakes, high-fidelity experiential learning remains constrained: due to risk aversion and administrative burden, universities offer minimal scaffolding for legally and financially complex activities—including product prototyping, formal company incorporation, intellectual property assignment, and equity structuring [9]. Similarly, university-affiliated incubators predominantly provide infrastructural and procedural support, such as shared workspace, basic registration assistance, and occasional guest seminars, while falling short in delivering discipline-specific, venture-ready resources: dedicated pilot-scale testing facilities, concept validation grants, and curated industry partnerships aligned with technical domains.

2.2 Faculty Capacity: Structural Deficits and the Absence of Institutionalized Collaborative Mentorship

Faculty capacity is critical to educational quality. The challenges in postgraduate I&E education faculty are reflected mainly in the following aspects.

2.2.1 Disciplinary knowledge gaps within core academic faculty

Instructors delivering foundational I&E theory courses are predominantly drawn from disciplines such as economics, management, and philosophy—fields whose epistemological frameworks emphasize conceptual modeling and normative analysis rather than technical implementation. Consequently, many lack substantive familiarity with frontier technologies (e.g., generative AI, quantum computing), the practical complexities of engineering prototyping and scale-up, and the iterative, uncertainty-laden dynamics of academic research workflows. This knowledge gap significantly impedes their ability to guide science and engineering postgraduate students in addressing domain-specific challenges inherent to technology-based ventures—such as feasibility assessment of lab-to-market translation, intellectual property strategy formulation, or regulatory pathway navigation. Moreover, genuinely 'dual-qualified' faculty—defined as individuals possessing both deep disciplinary expertise and sustained, high-level professional experience in industry research and development, product commercialization, or venture leadership—remain exceptionally rare. Most subject-matter supervisors follow a traditional academic career path, characterized by continuous immersion in scholarly inquiry and publication. Although they have solid theoretical grounding and strong research innovation capabilities, they generally lack hands-on experience in corporate positions, product development, or market operations, making it difficult for them to offer an industry perspective that goes beyond the laboratory [10].

2.2.2 Institutionalized path dependence and cognitive-resource constraints of the sole-supervisor model

Faculty supervisors operate within an incentive architecture overwhelmingly oriented toward traditional academic outputs: scholarly publications, competitively funded research

projects, and disciplinary awards. This performance regime systematically privileges research trajectories that yield rapid, low-risk, publication-ready outcomes over high-uncertainty, long-horizon, application-oriented innovation endeavors requiring iterative prototyping, stakeholder engagement, and market feedback. Consequently, supervisors frequently steer postgraduate students toward incremental, theory-anchored investigations rather than transformative, problem-driven ventures [11]. Compounding this structural bias is the inherent limitation of individual supervisory capacity: a single faculty member's disciplinary expertise, professional networks, and cognitive frameworks constitute a bounded epistemic and relational resource. When confronted with multifaceted innovation challenges, the sole-supervisor model proves structurally inadequate, as no individual can credibly command depth across such divergent domains [12]

2.2.3 Ritualized engagement and structural marginalization of industry mentors

The appointment of industry mentors frequently devolves into symbolic or reputational gestures rather than rigorous alignment with pedagogical needs. Candidates are seldom subject to systematic vetting of their domain-specific expertise, mentoring competency, or demonstrable time commitment. Furthermore, the majority serve in an unpaid or nominally compensated capacity, often receiving only honorary titles without commensurate remuneration or professional recognition. Critically, formal accountability mechanisms remain underdeveloped. Clear, codified expectations, such as minimum contact hours per semester, defined roles in milestone reviews, or co-supervision responsibilities are absent. Likewise, meaningful incentives remain rare, including honoraria for sustained engagement, eligibility for joint research funding, equity-linked participation in student ventures, and formal academic affiliation. As a result, mentor involvement is typically episodic and peripheral: limited to one-off guest lectures or panel discussions, with negligible influence on curriculum design, pedagogical delivery, or thesis supervision. Industry mentors are systematically excluded from core academic governance functions—such as postgraduate program review, capstone course development, and final thesis evaluation—rendering their deep sectoral knowledge structurally disconnected from the pedagogical value chain and preventing its integration into learning outcomes, assessment criteria, or innovation project scaffolding [13].

2.3 Student Perceptions: The Cognitive disconnection Between Innovation and Entrepreneurship

2.3.1 Instrumental dichotomy: entrepreneurship as a marginalized academic capability

A dominant instrumental orientation among postgraduate students treats innovation as intrinsically academic, while casting entrepreneurship as a secondary, pragmatic recourse: pursued only when traditional academic or industrial career trajectories prove inaccessible. This mental partition collapses entrepreneurship into the singular act of departing academia to found a startup, and eclipses its essential nature as a broadly applicable, discipline-transcendent capacity, the structured ability to detect latent societal or market needs, assemble diverse resources across boundaries, formulate scalable value propositions, and advance through ambiguity via methodical experimentation. Rather than occupying the periphery of scholarly distinction, these capabilities are now central to achieving real-world research impact, synthesizing knowledge across fields, and exercising leadership across universities, enterprises, and public-sector organizations [14].

2.3.2 Epistemic risk aversion: the tension between academic certainty and entrepreneurial uncertainty

Postgraduate education represents a period of exceptionally high intellectual and temporal investment, where accumulated expertise constitutes substantial sunk cost [15]. Consequently, students exhibit pronounced risk aversion when confronting entrepreneurial pathways. Compounding this is a deep-seated epistemological mismatch: academic training cultivates a logic of verification, whereas entrepreneurial practice operates through a logic of validation—emphasizing rapid prototyping, stakeholder feedback loops, iterative pivoting, and learning from failure. Without deliberate scaffolding to reconcile these paradigms, the very cognitive habits that enable scholarly success can inadvertently constrain entrepreneurial agency.

2.3.3 Structural invisibility: how evaluation

regimes undermine entrepreneurial identity formation

Despite national policy initiatives to dismantle the "Five Onlys" (overreliance on papers, titles, degrees, awards, and projects), institutional evaluation practices remain overwhelmingly anchored in traditional academic outputs. The ambiguous status of I&E achievements in evaluation systems directly signals to students that "this does not matter." Moreover, existing evaluation systems, even when they recognize successful entrepreneurial "outcomes," fail to capture and value the entrepreneurial spirit demonstrated in failed projects, further suppressing students' willingness to undertake high-risk exploration.

3. Systemic Reform Pathways for Postgraduate I&E Education

3.1 Pathway One: A Tiered, Discipline-Embedded Curriculum Architecture

Curriculum serves as the primary vehicle for normative alignment between disciplinary mastery and entrepreneurial agency. A robust framework must progress from foundational awareness to domain-specific application and culminate in authentic, high-stakes implementation to ensure each tier reinforces, rather than contradicts.

3.1.1 Foundational literacy layer

To cultivate conceptual clarity, dispel misconceptions, and establish entrepreneurship as a rigorous, learnable discipline, core courses including Innovation Systems Thinking, Entrepreneurial Strategy for Scientists and Engineers, Ethics, Law, and Intellectual Property in Technology Ventures are necessary. They emphasize evidence-based frameworks over anecdotal narratives. Instruction integrates case studies drawn from diverse innovation contexts: AI ethics governance, climate-tech commercialization, frugal innovation in global health, and open-science infrastructure development. The Integration point require students to discuss topics in relation to their own disciplinary fields, allowing them to initially perceive the connection between specialized knowledge and commercial value, such as cutting-edge technology in STEM, business model innovation in humanities/social sciences, smart agriculture applications in agronomy.

3.1.2 Disciplinary integration layer

To transform professional coursework into sites of entrepreneurial sensemaking, discipline-informed innovation modules, faculty redesign syllabi to embed modules and analysis of the Pathways and cases of scientific research achievements transformation should be supplied. Students undertake open-ended challenges grounded in authentic problems though Project-Based Learning (PBL) with Dual Assessment Criteria. For example, computer science students could design an app prototype addressing a social pain point and discuss its business model; materials science students could identify potential application scenarios for a novel material they developed and conduct a market analysis [16]. It requires that disciplinary faculty possess basic I&E awareness and that course design and assessment explicitly value students' innovative thinking and commercialization reasoning.

3.1.3 The practical application layer

To cultivate high-caliber innovative talents through authentic, industry-integrated practice environments and strengthen students' integrated competencies and accelerating the translation of outstanding research-driven projects into tangible outcomes, compulsory practice credits are awarded for demonstrable engagement in high-impact activities, including participation in nationally or internationally recognized entrepreneurship and innovation competitions; execution of mission-oriented, industry-sponsored projects; formal enrollment in university-affiliated or government-accredited incubators; successful technology transfer. The following is Postgraduate Innovation Lab & Incubation Workshop which is a cross-disciplinary platform equipped with prototyping infrastructure, domain-expert faculty mentors, and seed funding support. It enables postgraduate students to advance from concept validation through functional prototyping, iterative small-batch manufacturing, and evidence-based market feasibility assessment. University–Industry Collaborative Practice Bases are strategic partnerships with industry-leading enterprises, national-level science parks, and professional venture capital or technology transfer institutions. Selected postgraduate students undertake structured, semester-long placements at partner organizations to conduct co-develop internal innovation solutions and operationalize experiential learning grounded in real-world technological and market challenges. All practice projects must be substantively

rooted in the student's disciplinary research focus or constitute a rigorous extension to ensure scientific rigor, technological novelty, and domain-specific depth. Superficial or non-technical entrepreneurial endeavors are explicitly excluded.

3.2 Pathway Two: Fostering a Tripartite Faculty Ecosystem

3.2.1 Implement an "I&E faculty capability enhancement plan"

Establish a system for faculty to work in enterprises on secondment, serve as technical advisors, or participate in startup projects, and make this a significant consideration in promotion and performance evaluation [17]. Regularly organize I&E pedagogy training and case-development workshops to enhance faculty's teaching design and mentoring skills.

Embed foundational I&E competencies—including I&E mindset cultivation, opportunity recognition frameworks, and translational research guidance—into mandatory onboarding curricula and sustained professional learning pathways for all postgraduate supervisors. Explicitly orient supervisors to reconceptualize research supervision as a conduit for nurturing students' capacity to identify industrially salient problems, formulate use-inspired hypotheses, and pursue scalable solutions. Incentivize the alignment of doctoral and master's thesis topics with validated industry challenges and emerging technology roadmaps, thereby reinforcing the nexus between advanced scholarship and societal application.

Postgraduate supervisor "I&E literacy training" integrate I&E education concepts and methods into supervisor onboarding and ongoing development programs. Guide supervisors to recognize the importance of nurturing students' innovative thinking and entrepreneurial spirit, and to master basic mentoring techniques. Encourage supervisors to incorporate industry needs into research topic selection, supporting students in pursuing application-oriented projects.

3.2.2 Improve the "dual mentor system" and the "mentor group system"

Define the second mentor's responsibilities and benefits: Clarify the second mentor's (typically an external industry mentor) specific duties in postgraduate training, such as participating in training plan design, guiding practice components, delivering frontier lectures, and providing internship opportunities [18]. Correspondingly, grant appropriate honoraria, recognition, and decision-making involvement.

Institutionalize the Supervisory Committee Model: For postgraduate students enrolled in the practice-intensive layer, mandate the formation of a tripartite Supervisory Committee comprising: (i) the primary academic supervisor (ensuring disciplinary rigor and research integrity); (ii) the second supervisor (providing domain-specific industry insight, real-world problem framing, and translational feasibility assessment); and (iii) a dedicated innovation and entrepreneurship educator (delivering structured training in design thinking, lean startup methodology, intellectual property strategy, and stakeholder engagement). The Committee shall convene biannually for integrated progress reviews, risk-mitigation planning, and adaptive adjustment of supervision strategies—thereby operationalizing synergistic mentorship grounded in complementary expertise and shared accountability [19].

3.2.3 Establish an open, adaptive, and verified mentor registry for I & Education

Deploy a secure, university-managed online platform serving as a centralized, searchable registry of qualified mentors. Each profile shall comprehensively document verified credentials including primary industry sector, domain-specific technical competencies, proven impact (e.g., patents commercialized, ventures scaled, policy influence), availability windows aligned with academic cycles, and preferred modes of engagement (e.g., advisory board membership, capstone supervision, workshop facilitation). Postgraduate students initiate mentor matching by submitting structured project briefs; the system then recommends optimal mentors based on algorithmic alignment of project scope, technical requirements, and mentor capacity, enabling evidence-based, needs-driven pairing rather than self-selection.

Outstanding external mentors who demonstrate sustained, high-impact contributions to postgraduate education and innovation ecosystems may be appointed to the formal academic rank of "Industry Professor". Appointees are granted full voting rights in relevant postgraduate program committees and formal eligibility to serve as internal examiners on master's and doctoral thesis defense panels, thereby institutionalizing industry voice in academic quality assurance and degree conferral

processes.

3.3 Pathway Three: Advance the Integrated Conceptual Transformation Initiative—Value Anchoring, Cultural Integration, and Structural Incentivization

3.3.1 Value anchoring: reframing "success" and "entrepreneurship"

Strategic Awareness-Building Program: Systematically deploy high-impact communication channels, including the inaugural academic orientation lecture, curated dialogues with distinguished scholars and industry pioneers, and peer-led narratives by alumni who exemplify diverse I&E pathways, to normalize and valorize pluralistic forms of entrepreneurial agency: 'intrapreneurship' 'occupational entrepreneurship', and 'social entrepreneurship'. Critically, position the entrepreneurial mindset not as a vocational choice, but as a transferable cognitive disposition encompassing opportunity sensitivity, adaptive problem-solving, and responsible value creation.

Exemplar-Based Identity Development: Intentionally identify, rigorously vet, and publicly recognize a cohort of "Research-Informed Founders" who have translated peer-reviewed research outputs into commercially viable or socially impactful ventures. Disseminate their stories through institutional publications, digital storytelling platforms, and faculty-student seminars to empirically demonstrate the synergistic relationship between scholarly rigor and entrepreneurial execution and to affirm that academic distinction and real-world impact are mutually reinforcing dimensions of excellence.

3.3.2 Cultural integration: cultivating a psychologically safe and experimentation-enabling campus ecosystem

Structured, Low-Stakes Innovation Engagement: Institutionalize recurring, accessible experiential learning opportunities, including "Idea Bazaars" (pop-up forums for rapid prototyping and peer feedback), time-bound "Innovation Sprints" (e.g., 48-hour design challenges grounded in real-world industry briefs), and discipline-anchored "Innovation Dialogues". These initiatives deliberately lower entry barriers, while fostering iterative experimentation, collaborative ideation, and reflective practice within a supportive academic environment.

Formalized Reflection on Setbacks: Launch a university-endorsed "Lessons from Setbacks" seminar series, wherein faculty, alumni, and industry partners transparently present rigorously analyzed case studies of project discontinuations, prototype failures, or market-entry missteps. Each session emphasizes methodological debriefing, thereby reframing setbacks not as indicators of deficiency, but as essential, high-yield learning inputs integral to robust innovation capacity development. This structured normalization of productive failure mitigates performance anxiety, strengthens cognitive resilience, and cultivates the reflective tenacity required for long-term scholarly and entrepreneurial success.

3.3.3 Institutional incentives: incorporating the achievements of I&E into the evaluation system

Explicitly incorporate rigorously validated I&E outcomes into core academic reward and progression mechanisms, including postgraduate merit-based scholarship allocation, nomination for university-level distinction awards (e.g., "Outstanding Postgraduate" or "Innovation Pioneer Award"), and formal degree requirements. Each output category shall carry quantifiable, transparent weight—calibrated to ensure substantive equivalence in academic value to peer-reviewed journal publications or conference proceedings of comparable rigor [20].

Establish a university-coordinated "I&E green channel", co-located with and operationally integrated into the Technology Transfer Office (TTO) and University Science Park (USP). This channel provides end-to-end, student-facing support, including provisional patent filing assistance, prior-art search and freedom-to-operate analysis, market feasibility assessment, investor-readiness coaching, and facilitated licensing or spin-out incubation pathways. By enabling tangible, timely validation of intellectual contribution, the channel transforms abstract ideation into concrete academic and professional capital, allowing students to directly perceive the value of their creative ideas and thus stimulating intrinsic motivation.

Through these detailed and systematic pathways, the blueprint for postgraduate I&E education reform becomes clearer and more actionable, promising to address existing problems in a comprehensive manner and genuinely cultivate high-level, innovative talent prepared for the future.

4. Implementation Safeguards and Anticipated Outcomes of the Reform

4.1 Implementation Safeguards

4.1.1 Governance and institutional framework

Establish a university-level "Postgraduate I&E Steering Committee", led by the President and comprising senior representatives from the Postgraduate School, Office of Student Affairs, Office of Research, TTO, USP, and all academic colleges. The Committee shall exercise strategic oversight, approve cross-departmental action plans, resolve jurisdictional ambiguities, and ensure alignment with national innovation policy and institutional academic mission. Complement this governance structure with formally adopted, legally vetted "Implementation Guidelines for Advancing Postgraduate I&E Education Reform", which codify clearly delineated mandates, accountability mechanisms, performance indicators, and inter-unit coordination protocols for all stakeholders.

4.1.2. Resource allocation and infrastructure development

Allocate dedicated, multi-year funding through a "Postgraduate I&E Capacity-Building Fund", administered transparently by the Postgraduate School in consultation with the TTO and Finance Office. Resources shall support evidence-based curriculum redesign, discipline-specific pedagogical training for faculty and industry mentors, seed grants for student-led ventures, and merit-based recognition awards. Concurrently, develop purpose-built, technology-enabled physical and virtual learning environments, such as the "Postgraduate Innovation Commons", being designed to foster sustained engagement, knowledge co-creation, and translational practice across the research-to-impact continuum.

4.1.3. Rigorous evaluation and continuous improvement cycle

Implement a comprehensive, outcomes-oriented evaluation framework grounded in the Plan-Do-Study-Act (PDSA) model. This framework shall include validated metrics across four domains: (i) curricular effectiveness (e.g., learning gain in entrepreneurial competencies, course completion rates); (ii) faculty development impact (e.g., mentor certification rates, industry engagement intensity); (iii) student experience and agency (e.g., longitudinal satisfaction surveys, self-efficacy indices, diversity of participation); and (iv) translational outcomes (e.g., patents licensed, societal impact verified via third-party assessment). Evaluation findings shall inform biannual review cycles, triggering data-driven refinements to programming, resource allocation, and policy implementation, ensuring adaptive, evidence-informed evolution of the I&E ecosystem.

4.2 Anticipated Outcomes

Through systematic implementation of this reform framework, the following transformations are anticipated.

(1) The training model shift from a binary structure separating "disciplinary education" and "I&E education" to a deeply integrated one, significantly enhancing students' knowledge integration abilities and cross-disciplinary literacy.

(2) Faculties shift from "single academic supervision" to "academic and practical collaborative supervision," forming a well-structured, complementarily capable, and dynamic I&E mentor team.

(3) Postgraduate students' "innovative thinking" will move from spontaneous to deliberate, from closed to open; their "entrepreneurial mindset" will move from narrow to broad, from fear-driven to rational. They will become more adept at identifying and defining problems and more courageous in exploring and realizing value, regardless of whether they pursue academic careers, corporate employment, or independent entrepreneurship, they will possess stronger core competitiveness.

(4) More innovative projects originating from high-level postgraduate research with market value will emerge, effectively promoting technology transfer and serving regional economic development, creating a virtuous cycle between talent training and social contribution.

5. Conclusion

Postgraduate I&E education is a complex systemic endeavor that extends far beyond offering a few courses or organizing a few competitions. It touches upon fundamental aspects of postgraduate education: philosophy, training models, faculty structure, and evaluation standards. This study advances a tripartite reform framework—grounded in systems theory and evidence-informed practice—to catalyze structural transformation. The future of postgraduate education should cultivate not only inheritors and creators of knowledge but also

pioneers capable of translating knowledge into tangible forces that advance society and enhance human well-being. This requires us to have the courage to break free from established path dependencies, and with greater resolve and wisdom, propel postgraduate I&E education from the “periphery” to the “center,” from “quantitative expansion” to “qualitative transformation.” Ultimately, we must construct a new high-level talent development system that fully unleashes postgraduate students’ potential and meets future challenges, thereby laying a solid talent foundation for China to take its place among the leading innovation-driven nations.

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