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Issue Overview

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This issue of *Journal of Psychology & Education* brings together five articles that examine general education, medical knowledge, psychological mechanisms of addiction, applied undergraduate teaching reform, and theories of equality. The issue opens with a practice-based study of Tao Xingzhi's philosophy of "Life as Education" and its integration into general education at Chongqing College of Mobile Communication. The article shows how extracurricular practice, campus ecology, residential college systems, labor education, and volunteer activities can connect knowledge learning with lived experience.

The second article turns to the intersection of artificial intelligence and Traditional Chinese Medicine. It analyzes how AI diagnostic systems mediate the four diagnostic methods of inspection, auscultation-olfaction, inquiry, and palpation, and argues for a human-AI collaborative diagnostic model that preserves the interpretive and ethical role of the physician while using AI to support consistency, multimodal data integration, and knowledge transmission.

A third contribution examines distinct psychological pathways from childhood adversity to addictive outcomes among college students. Using structural equation modeling, the study compares internet-related addiction and nicotine dependence and highlights the parallel mediating roles of internalizing distress and externalizing dysregulation, suggesting that behavioral and substance-related addictions may require different prevention and intervention emphases.

The fourth article focuses on project-driven teaching reform in applied undergraduate education. Based on real enterprise projects and school-enterprise collaboration, it proposes an integrated course-project-training-evaluation model designed to improve students' engagement, practical application ability, job adaptability, and competence-oriented learning.

The issue concludes with a political-philosophical comparison of Rawls and Cohen on equality. By contrasting Rawls's institutional path of justice with Cohen's more demanding egalitarian ethos, the article clarifies two different approaches to equality and reflects on the coordinated role of institutions, moral motivation, and social ethos in contemporary theories of justice.

Together, these articles reflect the journal's interdisciplinary orientation. They connect educational practice, technological mediation, psychological research, applied talent cultivation, and normative political philosophy, offering multiple perspectives on human development, institutional reform, and social responsibility.

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A Practical Study on Integrating the Philosophy of "Life as Education" into General Education in Application-Oriented Universities: A Case Study of Chongqing College of Mobile Communication

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University-level project, Changji University: "Research on the Strategy for Shaping 'Chinese Heart and Chinese Soul' among Ethnic Minority University Students in Xinjiang" (Project No. KYWK002); University-level teaching reform project, Chongqing College of Mobile Communication: "Exploring the 'Creative Transformation and Innovative Development' Path of General Education in Residential Universities under the Background of the 'Second Combination'—Taking 'Wisdom of Chinese Philosophy' and 'The World Initiated by Socrates and Confucius' as Examples" (Project No. 25JG3036)

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Abstract

"Life as Education" is the core of Tao Xingzhi's educational thought and holds significant implications for the reform of general education in application-oriented universities. Since its establishment, the General Education Department of Chongqing College of Mobile Communication has integrated this philosophy into its general education framework, establishing a system of "extracurricular practice-based learning + on-campus educational ecology". Externally, using multidisciplinary courses as vehicles, the college connects knowledge with life through activities such as agricultural labor and intangible cultural heritage practices. Internally, relying on the college's residential college system, labor education, and coordinated volunteer activities, a closed-loop educational system is achieved. This practice realizes the unity of knowledge activation and competency cultivation, providing a valuable reference for general education in application-oriented undergraduate institutions.

Keywords: Life as Education; Tao Xingzhi; General Education; Chongqing College of Mobile Communication; Practice-Based Education

Tao Xingzhi's proposition of "Life as Education" constitutes a cornerstone of modern Chinese educational thought. Criticizing the model of "rote learning," he advocated for "Life as Education, Society as School, and the Unity of Teaching, Learning, and Doing," emphasizing the symbiosis between education and life—life as the source of education, and education as a necessity of life. The concept of "using life to educate, educating for life" breaks the constraints of the classroom and directly

targets the goal of cultivating new individuals equipped with both life skills and a sense of responsibility. This philosophy also provides a fundamental guideline for general education at Chongqing College of Mobile Communication. In an era where higher education focuses on cultivating application-oriented talents, Tao Xingzhi's thought becomes even more valuable. General education aims to cultivate well-rounded individuals, which highly aligns with the core tenet of "the symbiosis of life and education." However, the current problem in some universities' general education—the disconnect between classroom and life—is precisely the malady Tao Xingzhi criticized. Particularly in the transmission of traditional culture, only practical experience can achieve spiritual internalization, a concept consistent with the epistemology that "doing is the beginning of knowing." Over eleven years of dedicated practice, Chongqing College of Mobile Communication has integrated "Life as Education" into its curriculum, practices, and campus culture, building an educational system that "bridges on-campus and off-campus experiences and links the classroom with life." This approach transforms educational philosophy into tangible outcomes, providing a vivid model for the reform of general education in higher education institutions.

I. The Practical Philosophical View of Tao Xingzhi's Life Education

Mr. Tao Xingzhi, as a "great people's educator," advanced a theory of life education that is not merely a set of educational methods but a practical philosophy deeply rooted in Chinese soil, integrating Eastern and Western thought and oriented

towards reality. To deeply understand the value of the "Life as Education" philosophy in contemporary general education, it is first necessary to clarify its philosophical foundations—specifically, how Tao Xingzhi, drawing on dialectical and historical materialism, reconstructed the dialectical relationship between life and education, theory and practice. This practical philosophical perspective constitutes the soul of the general education reform at Chongqing College of Mobile Communication.

(I) The Ontology of "Life as Education": The Dialectical Unity of Life and Education

Although a student of John Dewey, Tao Xingzhi turned Dewey's "Education as Life" on its head, proposing "Life as Education." This reversal is not merely a play on words but a revolution in educational ontology. He stated: "Give education to life, use life to educate, and educate for the needs of life to move forward and upward." This means that life is no longer the external environment of education but constitutes the very substance and entirety of education. From an ontological perspective, life is the root and foundation of education: life determines education—its origins, purposes, content, and methods are all determined by life; simultaneously, education transforms life, as good education can guide life towards a higher realm of "moving forward and upward." This monistic dialectical thinking breaks the binary opposition between "knowledge" and "action," "school" and "society" in traditional education, establishing an educational worldview centered on life. As Professor Wang Hongxia

asserts, Tao Xingzhi defined the essence of education as "returning to the lifeworld and transcending it," which is the first principle of his practical philosophy.

(II) The Methodology of "Unity of Teaching, Learning, and Doing": The Unity of Knowledge and Action Centered on "Doing"

The core methodology of Tao Xingzhi's practical philosophy lies in the "Unity of Teaching, Learning, and Doing." Criticizing Wang Yangming's view that "knowledge is the beginning of action," he proposed that "doing is the beginning of knowing, and knowing is the achievement of doing," eventually forming the dialectical developmental view of "doing-knowing-doing." He emphasized: "How a thing is done is how it is learned; how it is learned is how it is taught; regarding the thing, it is doing; regarding oneself, it is learning; regarding others, it is teaching." Here, "doing" is not merely physical labor or blind action but a creative practice of "laboring with the mind while using the hands." It contains three indispensable elements: action, thought, and the generation of new value. "Doing is the beginning of knowing, and knowing is the achievement of doing" – this epistemology shifts the starting point of education from books to practice, from static reception to dynamic creation. His assertion that "action is the mother of thought" profoundly reveals the foundational significance of practice for the generation of theory, making education a living process of "unity of knowledge and action."

(III) The Field Theory of "Society as School": The Complete Liberation of Educational Space

If "Life as Education" is the ontology and "Unity of Teaching, Learning, and Doing" is the method, then "Society as School" is the spatial expansion of the practical philosophy. Tao Xingzhi used a vivid metaphor: "To release a caged bird into the sky to soar freely is to extend everything in the school into nature." He rejected the myth of the traditional school as an isolated unit of education, advocating that the entire society (villages, cities, factories, fields) serves as the venue for education. The philosophical significance of this proposition lies in the fact that education is no longer a privileged activity confined by walls but a universal practice of self-transformation and self-improvement by the people within the vast expanse of social life. It reflects Tao Xingzhi's respect for the people's status as subjects and highlights the people-oriented and practical nature of his educational philosophy.

Therefore, Tao Xingzhi's practical philosophy of life education is a philosophy centered on life as the core, employing "doing" as the method, and utilizing society as the field, aimed at cultivating "authentic individuals" possessing life skills, creativity, and the spirit to transform society. It fundamentally corrects the traditional educational drawbacks of "valuing knowledge over action" and "detachment from life," providing the most profound theoretical resources for the reform of general education in contemporary application-oriented universities. Chongqing College of Mobile Communication, standing precisely at this philosophical height, systematically translates the "Life as Education" philosophy into actionable educational practices.

II. Construction of a Pluralistic Model for Extracurricular General Education Practice

Tao Xingzhi's "Life as Education" philosophy, emphasizing the symbiosis of education and life, provides the fundamental guideline for general education at Chongqing College of Mobile Communication. Within the context of cultivating application-oriented talents, our general education core courses adhere to this philosophy, aiming to "understand life through economic thinking" and "cultivate character through ethical practice."

(I) Economics Course: Cultivating the Ability of "Applying Knowledge to Serve Society" in Daily Life

Departing from theoretical indoctrination, the course establishes a standardized process of "research-practice-seminar." Instructors lead interdisciplinary student teams to engage in rapeseed farming activities in Hechuan's farmlands. Students participate in cutting, transporting, and threshing rapeseed using traditional tools. Guided by farmers, students move from unfamiliarity to proficiency, appreciating the value of labor and the hardships of people's livelihoods, while enhancing the inclusiveness of general education through collaboration. After the labor, teachers and students move to a supermarket to investigate the "rapeseed oil industry chain," recording information on brands like (Jin Long Yu). They discover that genetically modified rapeseed oil is approximately 80% of the price of non-GMO oil, with older consumers focusing on price and younger ones on quality. In the

classroom, teachers deconstruct abstract concepts like "supply and demand" and "cost-benefit" using the research findings, making economic principles tangible and relatable through lived experience. During seminar sessions, students express their views based on economic principles. This model of "Unity of Teaching, Learning, and Doing" vividly exemplifies Tao Xingzhi's practical philosophy that "action is the mother of thought." Through their own "doing" (labor, research), students encounter genuine difficulties and questions (price differences, consumption preferences), which then drive "learning" (discussion, analysis) and "teaching" (instructor guidance, seminars), ultimately achieving the mutual construction of knowledge and action. This interdisciplinary integration cultivates students' general abilities to solve life problems using multidisciplinary knowledge.

(II) Philosophy Course: Practical Shaping of Humanistic Spirit and Value Identity

The course "The World Initiated by Socrates and Confucius" uses Confucian filial piety as its core carrier, focusing on the essential idea that "filial piety is the root of virtue" and extending to the ethical dimension of "respecting the elderly in one's own family and extending it to the elderly of others." It establishes a teaching pathway of "theoretical explanation—social practice—cultural integration," realizing the contextualization of ethical education. Breaking classroom boundaries, the course organizes faculty and students to visit the Heping Rehabilitation Nursing Home in Hechuan District, transforming "filial piety" from a conceptual term in classics into

concrete actions. Centered on "emotional companionship," students engage in conversations, daily care, birthday wishes, and other activities. The tea-presenting ceremony becomes a key vehicle for ethical interpretation—the careful selection of tea leaves, the meticulous control of water temperature, and the attentive method of pouring—each step imbued with the meaning of "respecting elders," allowing students to grasp the ethical essence of "filial piety rooted in reverence." This process profoundly embodies Tao Xingzhi's practical methodology of "laboring with the mind while using the hands." Students do not passively receive ethical dogma; rather, through the process of "doing" (presenting tea, providing companionship) involving physical participation and emotional investment, they achieve a direct, experiential knowledge (qin zhi) of the abstract concept of "filial piety." As Tao Xingzhi stated, "the root of true knowledge is anchored in experience." In authentic social scenarios, students acquire the "true knowledge" of ethics, transforming traditional culture from symbols in books into a living faith.

(III) History Course: Dynamic Cultivation of Cultural Heritage and Innovative Ability

The history course conducts joint teaching activities with the Xia 砚 (Xiayan) Intangible Cultural Heritage Museum. Through experiences in traditional crafts like rubbings and pyrography, a three-dimensional educational model of "theory + skill + culture" is constructed. The course invites Master Huang, an inheritor of intangible cultural heritage, for on-site guidance. His extensive practical experience effectively

complements the teaching of university faculty. The rubbing group focuses on traditional patterns such as tigers, roosters, and monkeys, completing steps from moistening the paper, covering it with a cloth, tapping, and coloring under the inheritor's guidance. The pyrography group uses gourds as a medium, focusing on the critical aspect of "temperature control." This model of "inheritor-led practice and reflection" is an exemplar of Tao Xingzhi's practical philosophy that "doing is the beginning of knowing." Students do not learn about intangible cultural heritage by listening to lectures in the classroom but directly enter the stage of "doing"—during tapping and pyrography, they encounter concrete difficulties ("how to control the temperature," "how to make the pattern clear"), which generate questions. The questions drive hypotheses (adjusting force, changing angles), which are then tested through repeated trials to reach conclusions, ultimately forming true knowledge of the craft. This is a practical unfolding of Tao Xingzhi's dialectical epistemology: "Action gives rise to difficulty; difficulty gives rise to doubt; doubt gives rise to hypothesis; hypothesis gives rise to experiment; experiment gives rise to judgment; judgment gives rise to new action."

III. Systematic Construction of an On-Campus General Education Practice System

Extracurricular course practice primarily addresses "how knowledge is activated," while the on-campus educational ecology undertakes the function of "how competencies are internalized." Relying on its residential college system, labor

education, and volunteer services, Chongqing College of Mobile Communication has established an on-campus educational closed-loop characterized by "community-based living + normalized practice + socialized service."

(I) Residential College System: A Core Hub for Community-Based Cultural Heritage

The residential colleges at Chongqing College of Mobile Communication serve as the core vehicle for the "second classroom" of general education. Utilizing the interdisciplinary mentor system, they integrate cultural heritage into daily life scenarios. The "Sanjiang Qihuang" Traditional Chinese Medicine Health Night Market, organized by Huaguo Residential College, attracted over 800 faculty and students for immersive participation. Physicians provided on-site pulses diagnosis and moxibustion services, while students engaged with TCM wisdom through activities like DIY herbal sachets and weaving wristbands based on the Five Elements. Regular activities such as sachet-making and tea tasting further deepen students' understanding of traditional culture. The essence of the residential colleges lies in the spatial practice of "Life as Education." This highly aligns with Tao Xingzhi's concept of "Society as School"—the residential college itself is a small society, and the cultural life students lead there (tea appreciation, sachet-making, consultations) constitutes the cultural education they receive. As Tao Xingzhi said, "the life one leads is the education one receives." Residential college life transforms cultural heritage from "passive

reception" to "active participation," enabling students to construct their cultural identity through daily life.

(II) Labor Education: Value Shaping through Normalized Practice

The campus lotus root digging activity, a core component of on-campus labor education, has been held annually since 2012 for 14 consecutive years, with over 15,000 student participants Cumulatively. It has been featured in China Education Daily. The college has designated a 3-acre practice base and established a three-dimensional assessment standard involving "practical operation + outcome report + peer evaluation," linking it to credits for the "Labor Education" course. Students form teams based on their residential colleges, collaborating in the muddy fields. Through the process of digging for lotus roots, they directly experience the dialectical relationship between "effort and harvest." This labor education practice profoundly embodies Tao Xingzhi's practical philosophy of "laboring with the mind while using the hands." Students not only engage in physical labor ("using the hands") but also in mental labor ("using the mind")—they need to think about how to collaborate to improve efficiency, how to minimize damage to the lotus roots, and write reflection reports after the activity, elevating their labor experience into a conscious understanding of values like "the utmost honor of labor" and "team collaboration." This completes the spiral process Tao Xingzhi described as "action—knowledge—renewed action," achieving the internalization of value shaping.

(III) Volunteer Services: Cultivating Responsibility through Socialized Practice

Chongqing College of Mobile Communication has established a volunteer service system characterized by "two-level university/institutional coordination + digital management," extending general education into the social realm. The University-level Youth Volunteer Federation coordinates resources, while school-level associations conduct targeted services based on their disciplinary strengths. The "Zhiyuanhui" app enables comprehensive information management and articulation with the "Holistic Education" credit system. The university promotes diversified brand projects: establishing the "Huaguo" Volunteer Training School, advancing the "Rural Revitalization" special initiative, and co-building "Community Schools" with residential communities in Hechuan. Volunteer service is the most direct contemporary practice of Tao Xingzhi's "Society as School" philosophy. Students step out of the campus and into society. Through the act of "doing" by serving others and participating in social governance, they gain "experiential knowledge" (qin zhi) unattainable in the classroom. Encountering difficulties while interacting with diverse populations, they generate questions and learn to respond, completing their social development. This model of "learning through service" tempers students' sense of social responsibility, public spirit, and civic capacity in the crucible of authentic social life, embodying Tao Xingzhi's dedication, as expressed in the phrase, "Come with a heart dedicated to service, take not a single blade of grass."

IV. The Value Implications of General Education Practice at Chongqing College of Mobile Communication

The "off-campus and on-campus dual-wheel drive" general education system, constructed by Chongqing College of Mobile Communication with "Life as Education" at its core, has effectively addressed the challenges of traditional general education, namely "fragmented knowledge and ritualized practice," achieving a progressive development of "knowledge-practice-value." Its core value lies in its threefold response to Tao Xingzhi's practical philosophy. **First**, it practices the epistemology of "doing is the beginning of knowing," promoting knowledge activation. From the agricultural research in the economics course to the nursing home practice in the philosophy course and the intangible cultural heritage experience in the history course, our general education consistently adheres to the principle of "learning by doing." Students gain "experiential knowledge" through direct experience, which then serves as the basis for absorbing "secondhand knowledge" and "inferred knowledge," transforming abstract theory into applicable, perceptible practical wisdom. This is not just an innovation in teaching methods but a localized practice of Tao Xingzhi's "doing-knowing-doing" dialectical epistemology. **Second**, it implements the methodology of "laboring with the mind while using the hands," achieving value guidance. Whether it is the realization of "effort and harvest" in lotus root digging or the empathy of "helping others and helping oneself" in volunteer service, our general education refuses the separation of knowledge and action, consistently insisting on the "integration of hand and brain." Students achieve spiritual

sublimation ("using the mind") through physical exertion ("using the hands"), internalizing external knowledge into their own character traits, thereby achieving the unity of "scoring points and educating the person." **Third**, it expands the field theory of "Society as School," cultivating well-rounded individuals. Through the living community of the residential college system, the social classroom of off-campus practice, and the vast realm of volunteer service, our university has broken down the walls of traditional education. Students construct a comprehensive connection between "the individual and society" through diverse life practices, growing into application-oriented talents equipped with professional competence, life wisdom, and a sense of social responsibility.

V. Conclusion

The general education practice at Chongqing College of Mobile Communication represents both an inheritance and innovation of Tao Xingzhi's "Life as Education" philosophy and a contemporary transformation of its practical philosophy. Its core lesson is: The essence of general education is "to bring knowledge back to life," and the essence of life is practice. Only by extending the educational context to the social scene and integrating it into the practices of life, enabling students to personally "do" and actively "act," can they labor with their minds while using their hands, seek knowledge through action, and achieve self-realization through creation. Within the context of cultivating application-oriented talents, the university's exploration provides a replicable and

transferable practical experience for similar institutions and offers a vivid model for the contemporary transformation of Tao Xingzhi's educational thought. In the future, general education in higher education institutions needs to further deepen its integration with life and practice, constructing a more vibrant educational system through theoretical innovation and practical exploration, ultimately realizing the ultimate mission of education "to return to the lifeworld and transcend it."

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**Artificial Intelligence Diagnostic Systems and the Cognitive Model of
Traditional Chinese Medicine: Knowledge Transformation under
Technological Mediation**

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Abstract

The application of artificial intelligence (AI) to Traditional Chinese Medicine (TCM) diagnosis has generated a profound epistemological debate concerning the nature of medical knowledge, the status of clinical experience, and the transformation of diagnostic cognition under technological mediation. Focusing on the four diagnostic methods of inspection, auscultation-olfaction, inquiry, and palpation, this paper examines how AI systems reshape the traditional cognitive model of TCM by transforming sensory, experiential, and holistic forms of judgment into standardized and computable data. Drawing on systems theory, fuzzy logic, tacit knowledge theory, and recent studies of machine learning in TCM diagnosis, the paper argues that AI can improve diagnostic consistency, data integration, and knowledge transmission, but it may also intensify tensions between standardization and individualization, reductionist feature extraction and holistic pattern differentiation, and algorithmic authority and the physician's clinical responsibility. To address these tensions, the paper proposes a human-AI collaborative diagnostic model in which AI serves as an augmentative instrument rather than a replacement for the TCM physician. The proposed model emphasizes TCM-informed algorithm design, multimodal data integration, transparent reasoning, longitudinal personalization, and ethical governance. The study contributes to debates on the modernization of TCM by showing that knowledge transformation should not be understood as the passive digitization of tradition, but as a reciprocal process in which classical diagnostic wisdom and contemporary computational technologies jointly reshape the future of medical cognition.

Keywords: artificial intelligence; Traditional Chinese Medicine diagnosis; inspection, auscultation-olfaction, inquiry, and palpation; cognitive model; human-AI collaboration; knowledge transformation

1. Introduction

The diagnostic core of Traditional Chinese Medicine (TCM) is conventionally summarized as the four diagnostic methods: inspection, auscultation-olfaction, inquiry, and palpation. Through observation of the complexion and bodily form, attention to voice and odor, systematic questioning about symptoms and life history, and palpation of the pulse and related bodily signs, the physician forms an integrated judgment about the patient's pattern of disharmony. This diagnostic practice is not merely a collection of techniques. It embodies a distinctive cognitive style that emphasizes relational thinking, dynamic balance, contextual interpretation, and individualized pattern differentiation.

In recent years, AI technologies have begun to enter the domain of TCM diagnosis. Machine learning methods are now used to analyze tongue images, pulse-wave signals, clinical notes, and multimodal diagnostic data. Recent reviews show that AI-enabled TCM diagnosis has rapidly expanded across the four diagnostic methods and that machine learning is increasingly used to reduce subjectivity, improve reproducibility, and support clinical decision-making (Tian et al., 2024). Similar developments are visible in AI-assisted tongue image analysis, electronic health record mining, and syndrome prediction (Liu et al., 2023; Wang et al., 2020; Zhang et al., 2020).

This technological transformation raises questions that are philosophical as well as clinical. Can an AI system genuinely participate in TCM pattern differentiation, or can it only approximate visible correlations among signs and syndromes? How should the ambiguity of TCM categories, such as 'slippery pulse,' 'greasy coating,' or 'deficiency heat,' be represented in computational models? What happens to the authority of tacit clinical experience when diagnostic suggestions are generated by statistical or neural-network systems? These questions point to the deeper issue of knowledge transformation: AI does not simply copy traditional

practice, but reorganizes how diagnostic knowledge is collected, represented, validated, and transmitted.

The purpose of this paper is to analyze the impact of AI diagnostic systems on the cognitive model of TCM and to propose a framework for human-AI collaborative diagnosis. The paper proceeds in eight parts. Section 2 clarifies the major cognitive characteristics of TCM diagnosis. Section 3 examines the mechanisms through which AI intervenes in diagnostic practice. Section 4 analyzes the tensions and possible integrations between TCM cognition and computational reasoning. Section 5 proposes a human-AI collaborative model. Section 6 discusses future technological pathways. Section 7 provides illustrative case analyses. The conclusion argues that the modernization of TCM should be understood as an interactive process in which AI augments, but does not replace, the interpretive and ethical work of the physician.

2. Cognitive Characteristics of TCM Diagnosis

2.1 Holism and Systemic Reasoning

The first cognitive feature of TCM diagnosis is holism. Classical TCM theory assumes that the human body is an integrated system in which local signs reflect systemic conditions. The traditional maxim that internal disorder manifests externally expresses this assumption: visible changes in the face, tongue, posture, voice, or pulse are not treated as isolated symptoms but as clues to an underlying pattern. This holistic orientation has affinities with modern systems theory, which argues that the properties of a system cannot be fully reduced to the sum of its parts (Bertalanffy, 1968).

Inspection, especially the assessment of vitality or spirit, illustrates this holistic logic. When physicians evaluate whether a patient has 'spirit' or has lost vitality, they are not simply recording an objective feature in the manner of a laboratory value. They are integrating multiple

cues, including facial expression, eye brightness, voice, responsiveness, complexion, and bodily movement. Such judgments are difficult to quantify, yet they often guide clinical expectations about disease severity and prognosis.

The six-channel differentiation system associated with the Shanghan tradition also demonstrates dynamic systemic thinking. The six channels are not discrete compartments but patterns of transformation through which disease may progress, reverse, or change direction. Diagnostic reasoning therefore requires attention to temporal evolution, not merely static classification. This is a crucial challenge for AI systems: a TCM-informed model must represent dynamic relations among signs, patterns, constitutions, seasons, and treatment responses rather than only map symptoms to labels.

2.2 Ambiguity, Fuzzy Categories, and Tacit Judgment

A second feature of TCM diagnosis is its productive use of ambiguity. Many diagnostic descriptors, including 'yellow and greasy coating,' 'slippery pulse,' 'wiry pulse,' 'cold-dampness,' or 'blood stasis,' are not rigid categories with sharply defined boundaries. Their meanings are graded, contextual, and relational. Ambiguity in this sense is not a failure of scientific precision; it is a flexible cognitive strategy that allows physicians to reason under conditions of complexity and individual variation.

Zadeh's (1965) theory of fuzzy sets offers a useful conceptual bridge. In fuzzy logic, an object may belong to a category by degree rather than simply being inside or outside it. This logic resonates with the TCM understanding of yin-yang transformation, where pathological states are often transitional, mixed, or coexisting rather than binary. A patient may show signs of both deficiency and excess, or cold in one domain and heat in another. Computational models that force these patterns into hard labels risk losing clinically meaningful intermediate states.

TCM diagnosis also relies heavily on tacit knowledge. Polanyi (1966) famously argued that human beings know more than they can explicitly state. This insight is highly relevant to the diagnostic expertise of experienced TCM physicians. Experts often recognize a pattern quickly, not because they follow a fully verbalized checklist, but because years of practice have trained their perceptual and interpretive capacities. The challenge for AI is therefore not only to extract explicit rules, but also to approximate forms of pattern recognition that have historically been transmitted through apprenticeship, observation, and repeated clinical practice.

2.3 Individualization and Pattern-Based Treatment

A third feature is individualization. TCM is often summarized by the principle that the same biomedical disease may require different treatments, while different biomedical diseases may be treated similarly if they share the same pattern. This principle reflects the centrality of pattern differentiation rather than disease naming alone. The diagnostic object is not simply the disease entity but the patient as a situated, temporally changing organism.

Constitution theory further illustrates this individualized orientation. Wang's (2009) model of nine constitutional types provides a structured way to think about relatively stable bodily tendencies, but clinical reality often involves mixed constitutions, life-stage changes, environmental influences, and lifestyle factors. A clinically useful AI system must therefore move beyond population-level classification toward models capable of learning patient-specific baselines and trajectories.

Time is also integral to TCM cognition. Seasonal rhythms, circadian variation, disease progression, and treatment timing all influence interpretation. The maxim of nourishing yang in spring and summer and nourishing yin in autumn and winter reflects a broader diagnostic temporality. AI has potential value here because longitudinal data, wearable signals, and

repeated clinical observations can help model temporal patterns that are difficult for physicians to track manually. However, such models must remain interpretable within TCM conceptual categories rather than functioning as opaque correlations detached from clinical meaning.

3. AI Intervention in Diagnostic Practice

3.1 Data Collection and Standardization

The first mode of AI intervention is datafication: the conversion of sensory and experiential diagnostic information into digital data. Tongue diagnosis systems use cameras and image-processing algorithms to identify tongue body color, coating thickness, coating texture, fissures, tooth marks, and sublingual veins. Pulse diagnosis devices use pressure sensors and signal-processing methods to capture pulse rate, amplitude, rhythm, waveform, and spatial differences across cun, guan, and chi positions. Inquiry data may be extracted from electronic health records through natural language processing or collected through structured questionnaires.

Datafication enables standardization. When lighting conditions, image calibration, signal acquisition, and annotation procedures are carefully controlled, AI systems can reduce inter-practitioner variability. Studies of tongue image analysis, for instance, have shown that deep learning can classify specific visual features such as tooth-marked tongue with high accuracy under defined experimental conditions (Wang et al., 2020). Broader surveys also indicate that tongue image analysis has become one of the most active areas in AI-TCM research (Liu et al., 2023).

At the same time, standardization may narrow the diagnostic field. A tongue image captured under standardized lighting may improve color consistency, but it may not capture the physician's broader impression of vitality, moisture, odor, patient behavior, or clinical context. Similarly, a pulse waveform can quantify pressure and rhythm, but it may not fully reproduce the

tactile experience of palpation. Thus, datafication should be treated as a partial translation of TCM diagnosis, not as its complete replacement.

3.2 Pattern Recognition and Knowledge Extraction

The second mode of intervention is pattern recognition. Deep learning systems can identify statistical associations among diagnostic signs, disease categories, and TCM syndromes. Convolutional neural networks are particularly suited to tongue and facial image analysis, whereas recurrent architectures and temporal models can be applied to pulse-wave data. Natural language processing can extract symptoms, treatment histories, and syndrome-related entities from unstructured clinical notes.

An illustrative example is the AI-based TCM assistive diagnostic system validated by Zhang et al. (2020). The system used natural language processing to extract clinical information from electronic health record notes and then predicted both biomedical disease categories and TCM syndromes. The study reported that the system could predict 187 TCM-related disease types from clinical notes, with top-one, top-three, and top-five accuracy levels of 80.5%, 91.6%, and 94.2%, respectively (Zhang et al., 2020). These findings suggest that AI can help organize large-scale clinical data and extend the knowledge base available to physicians.

However, pattern recognition also introduces the problem of opacity. Many high-performing models are difficult to interpret. A neural network may classify a tongue image as suggestive of damp-heat or spleen deficiency, but the physician may not know which features drove the output or whether the model relied on clinically meaningful cues. This black-box problem conflicts with the TCM tradition in which diagnosis is expected to be explainable in relation to pattern, pathogenesis, and therapeutic principle. Explainability is therefore not an optional technical feature; it is a condition for integrating AI into TCM reasoning.

3.3 Decision Support and Human-Computer Interaction

Current AI systems in TCM are best understood as decision-support tools. They can provide preliminary screening, retrieve similar cases, suggest possible syndromes, identify inconsistencies in medical records, and remind physicians of overlooked signs. They should not be treated as autonomous diagnosticians because TCM diagnosis involves interpretive, ethical, and communicative dimensions that exceed data classification.

Human-computer interaction design is therefore crucial. A useful system should support, rather than interrupt, the physician's diagnostic reasoning. It should allow physicians to enter qualitative observations, revise labels, document disagreement with AI outputs, and view the evidence behind each recommendation. In addition, it should support uncertainty rather than force premature closure. A ranked list of possible patterns, with interpretable evidence and confidence intervals, is often more clinically appropriate than a single categorical answer.

This design orientation is consistent with recent discussions of AI in TCM, which emphasize that AI can enhance diagnostic capacity but cannot replace the humanistic, relational, and contextual role of the practitioner (Li et al., 2024; Lu et al., 2024). The practical question is not whether AI or the physician should have sole authority, but how responsibilities should be distributed across a collaborative diagnostic system.

4. Tensions and Integrative Possibilities in Cognitive Transformation

4.1 Reductionism and Holism

A central tension lies between computational reductionism and TCM holism. AI systems often decompose diagnosis into measurable features: tongue color values, pulse amplitudes, symptom keywords, and probability scores. This decomposition is necessary for computation, but it may obscure the relational logic that gives TCM signs their meaning. A yellow greasy

tongue coating, for example, is not merely a color-texture combination; its significance depends on appetite, stool, thirst, pulse, constitution, duration, season, and treatment history.

Systems theory offers a conceptual remedy. If the body is understood as a complex adaptive system, then AI should not only classify isolated features but also model interactions among signs and contexts. Graph neural networks, knowledge graphs, causal models, and multimodal transformers are promising because they can represent relationships among symptoms, organs, patterns, formulas, and outcomes. The aim should be to translate TCM holism into relational computational structures rather than reduce it to a checklist of signs.

This point has practical consequences. A model that achieves high accuracy on a narrow image-classification task may still be insufficient for clinical TCM diagnosis if it cannot integrate inquiry, pulse, constitution, and temporal change. Conversely, an integrated multimodal system may be clinically more meaningful even if its performance on a single task appears less impressive. Evaluation metrics should therefore be aligned with the cognitive goals of TCM diagnosis.

4.2 Determinacy and Uncertainty

A second tension concerns uncertainty. AI systems often produce determinate outputs: a predicted label, a probability, or a ranked list. TCM diagnosis, however, frequently works through provisional judgment. Physicians may begin with a tentative pattern, observe treatment response, and revise the diagnosis as the patient's condition changes. Uncertainty is not merely a technical limitation; it is part of clinical reasoning.

Fuzzy logic and probabilistic reasoning provide potential solutions. Fuzzy membership functions can represent degrees of cold, heat, deficiency, excess, dampness, or stasis. Bayesian networks can update diagnostic probability as new information becomes available. Causal

reasoning can help distinguish correlation from pathogenesis, a distinction especially important in TCM's principle of examining manifestations to infer causes. Pearl's (2009) causal framework is useful here because it directs attention from prediction alone to mechanisms and counterfactual reasoning.

AI outputs should therefore make uncertainty visible. Instead of presenting a diagnosis as a fixed truth, systems should display competing pattern hypotheses, supporting and contradictory evidence, and possible next questions for clinical clarification. Such a design would better reflect TCM's diagnostic process, in which uncertainty is progressively reduced through observation, questioning, palpation, and therapeutic feedback.

4.3 Clinical Inheritance and Algorithmic Learning

A third tension concerns knowledge transmission. TCM has historically relied on classical texts, case records, apprenticeship, and embodied clinical training. AI introduces a new mode of learning based on large-scale data aggregation and algorithmic optimization. This can support the preservation and dissemination of expert knowledge, especially in contexts where apprenticeship resources are limited. Knowledge graphs and ontologies can formalize relations among symptoms, syndromes, formulas, herbs, and outcomes (Long et al., 2019).

Nevertheless, algorithmic learning cannot fully replace clinical inheritance. A dataset contains selected traces of practice, not practice itself. It may overrepresent certain hospitals, regions, diagnostic schools, or documentation habits. If the training data are biased, the model may reproduce or amplify those biases. In addition, some expert judgments are embodied and situational, emerging only in interaction with the patient. The challenge is therefore to build systems that learn from clinical tradition without flattening it into a rigid database.

A productive approach is to treat AI as a new medium of inheritance. Expert physicians can participate in annotation, rule design, case interpretation, and model evaluation. Younger physicians can use AI systems as learning tools that expose them to similar cases, alternative interpretations, and evidence behind diagnostic suggestions. In this way, AI can extend rather than interrupt the lineage of clinical learning.

Table 1 summarizes the main epistemic tensions and the corresponding design requirements for a human-AI collaborative TCM diagnostic system.

Epistemic tension	Risk in AI-mediated diagnosis	Collaborative design requirement
Holism vs. reductionism	Fragmenting pattern differentiation into isolated features.	Use multimodal and relational models that integrate tongue, pulse, inquiry, constitution, and temporal change.
Ambiguity vs. hard classification	Forcing fuzzy signs into rigid labels.	Represent graded membership, competing hypotheses, and diagnostic uncertainty.
Tacit expertise vs. explicit rules	Marginalizing experiential judgment and apprenticeship knowledge.	Include expert annotation, case-based explanation, and physician feedback loops.
Standardization vs. individualization	Overgeneralizing from population-level patterns.	Support patient-specific baselines, longitudinal learning, and individualized interpretation.
Algorithmic authority vs. clinical responsibility	Encouraging uncritical reliance on AI suggestions.	Maintain physician-led decision-making, transparent reasoning, and documented accountability.

5. A Human-AI Collaborative Model of TCM Diagnosis

5.1 Division of Labor

An appropriate collaborative model should assign tasks according to the strengths and limitations of each actor. AI is strong in large-scale data processing, consistent measurement, pattern retrieval, and the identification of statistical regularities. Human physicians are strong in

contextual interpretation, ethical judgment, flexible reasoning, patient communication, and the handling of atypical cases. Collaboration should therefore be designed around complementarity rather than substitution.

In practical terms, AI can assist with preliminary data acquisition, standardization, case retrieval, and risk alerts. For example, an AI system may identify subtle changes in tongue coating over repeated visits or detect inconsistencies between symptom reports and pulse-wave features. The physician then evaluates whether these findings fit the patient's overall presentation, life context, constitution, and treatment goals. Final diagnostic and therapeutic responsibility remains with the physician.

Feedback loops are essential. When a physician accepts, modifies, or rejects an AI suggestion, this decision should be recorded together with the clinical rationale and subsequent treatment outcome. Over time, such feedback can improve model calibration and help identify cases in which the system performs poorly. Human-AI collaboration should therefore be dynamic and learning-oriented rather than a one-way delivery of algorithmic recommendations.

5.2 Knowledge Augmentation and Capacity Expansion

AI can augment physicians' cognitive capacity by expanding the range of cases, literature, and historical records available during diagnosis. An expert system linked to a curated knowledge base could retrieve classical passages, modern clinical trials, similar cases, common formula modifications, and contraindications. This is especially valuable for younger physicians who are still developing clinical experience.

Visualization can also serve as a cognitive tool. Network diagrams that display relationships among symptoms, patterns, organs, formulas, and herbs may help physicians recognize hidden structures in complex cases. Longitudinal visualizations may show how a

patient's tongue, pulse, sleep, appetite, pain, and emotional state change across treatment. Such tools support TCM's dynamic view of illness and make the diagnostic process more transparent to both clinicians and patients.

Predictive modeling can further extend the TCM principle of preventive treatment. By learning from historical trajectories, AI may help identify patients at risk of pattern transformation, relapse, or adverse response. However, predictive suggestions should be framed as clinical prompts, not deterministic forecasts. The goal is to enhance the physician's anticipatory reasoning while preserving clinical judgment.

5.3 Ethics, Transparency, and Responsibility

Human-AI collaboration also requires ethical governance. The World Health Organization (2021) stresses that AI for health should protect autonomy, promote human well-being and safety, ensure transparency, foster responsibility, promote inclusiveness and equity, and remain responsive and sustainable. These principles are directly applicable to AI-TCM systems, particularly because TCM diagnosis often involves subjective signs, culturally specific concepts, and individualized treatment decisions.

Transparency is fundamental. Patients should be informed when AI tools are used in diagnosis or treatment planning. Physicians should be able to inspect the evidence supporting AI suggestions. Developers should document model training data, intended use, limitations, update procedures, and known failure modes. Reporting standards such as CONSORT-AI also indicate the broader importance of transparent clinical evaluation for AI interventions (Liu et al., 2020).

Responsibility must be clearly defined. In the model proposed here, AI functions as a diagnostic assistant under physician supervision. The physician remains responsible for clinical judgment, while medical institutions and developers share responsibility for system validation,

data security, usability, and post-deployment monitoring. This shared accountability is necessary to avoid both blind reliance on algorithms and unrealistic expectations that individual physicians can independently audit complex AI systems.

6. Future Pathways for Technological Development

6.1 TCM-Informed Algorithmic Architectures

Generic AI architectures may not fully fit the epistemology of TCM diagnosis. Future systems should be designed with TCM cognitive features in mind. Knowledge graphs can represent classical theory, syndrome relations, organ networks, formulas, and herbal properties. Deep learning can process high-dimensional clinical data. Hybrid systems that combine knowledge-driven and data-driven approaches may be especially appropriate because they can preserve theoretical structure while learning from clinical evidence.

Causal inference is another important direction. TCM diagnosis seeks to infer pathogenesis from manifestations, not merely to predict labels. Causal models can help distinguish symptoms that are central to a pattern from those that are incidental or confounded by other factors. Although causal inference in TCM will be methodologically challenging, it aligns better with the logic of pattern differentiation than purely correlational prediction.

Multimodal learning is also essential. Since the four diagnostic methods are complementary, AI systems should integrate visual, auditory, textual, tactile, and temporal data. A model that combines tongue images, voice features, pulse signals, inquiry responses, and treatment history would better approximate TCM clinical reasoning than a single-modality classifier. Yet multimodal integration requires careful attention to missing data, inconsistent measurement conditions, privacy, and interpretability.

6.2 Personalized and Longitudinal Models

The future of AI-TCM diagnosis should move from static classification to longitudinal personalization. Population-level models can provide useful baselines, but they often fail to capture individual constitution, environmental exposure, lifestyle, treatment history, and temporal change. Transfer learning and continual learning may allow general models to adapt to individual patients or specific clinical settings.

Longitudinal models are particularly important for chronic conditions. A patient's pattern may transform over weeks or months, and the meaning of a sign may depend on its direction of change. For example, a reduction in greasy coating after treatment may be more meaningful than a single cross-sectional measurement. Wearable devices, mobile health records, and repeated tongue or pulse measurements could provide data for modeling these trajectories, but clinical interpretation must remain grounded in TCM theory.

The concept of a digital twin is also relevant. A patient-specific digital model could simulate possible changes under different lifestyle or treatment scenarios. In TCM, such a model would need to incorporate not only biomedical variables but also constitution, pattern, emotional state, diet, sleep, seasonal exposure, and treatment response. While this remains an ambitious goal, it points toward a future in which AI supports individualized preventive care rather than merely classifying present symptoms.

6.3 Standardization, Interoperability, and Clinical Evidence

Standardization remains necessary for safe and reliable AI application. Data acquisition standards are needed for tongue images, pulse signals, voice recordings, inquiry forms, and syndrome labels. Without shared standards, models trained in one institution may fail in another

because of differences in lighting, devices, annotation conventions, patient populations, or terminology.

Algorithmic evaluation should include metrics that reflect TCM diagnostic goals. Conventional accuracy, sensitivity, specificity, and area under the curve are useful but insufficient. Evaluation should also examine syndrome differentiation consistency, interpretability, agreement with expert panels, effect on physician learning, impact on treatment decision-making, patient outcomes, and safety across demographic groups. External validation and prospective clinical studies are essential before broad deployment.

Interoperability is equally important. AI-TCM systems should be able to communicate with electronic health records, hospital information systems, and research databases while protecting privacy. Data governance should define who may access diagnostic data, how patient consent is obtained, how de-identified datasets are used, and how model updates are monitored. These governance issues are not secondary to technology; they shape the trustworthiness of the entire diagnostic ecosystem.

7. Illustrative Cases and Empirical Implications

7.1 AI-Enabled Tongue Diagnosis

Tongue diagnosis has become a prominent testing ground for AI-TCM because tongue images are relatively easy to digitize. Studies have applied deep learning to tongue segmentation, color correction, coating classification, tooth-mark recognition, and disease or syndrome differentiation. Wang et al. (2020), for instance, used convolutional neural networks to recognize tooth-marked tongue and reported overall model accuracy above 90% under experimental conditions. Reviews further show that tongue image analysis now includes a broad range of tasks, from feature extraction to disease screening and syndrome differentiation (Liu et al., 2023).

The empirical implication is twofold. On one hand, AI can provide objective reference points for features that are vulnerable to subjective variation, such as coating thickness or tooth marks. On the other hand, tongue diagnosis in clinical practice is not merely image classification. The significance of tongue features depends on inquiry, pulse, complexion, constitution, and therapeutic response. Tongue AI should therefore be integrated into a broader diagnostic system rather than used as a standalone substitute for clinical judgment.

7.2 Pulse Diagnosis and Instrumentation

Pulse diagnosis presents a more difficult challenge because it involves tactile perception, pressure modulation, spatial discrimination, and temporal rhythm. Instrumented pulse diagnosis can record waveform features, pulse intensity, rhythm, and pressure responses at different positions. Machine learning may then classify pulse patterns or associate signal features with syndromes. Recent reviews indicate that palpation-related AI research has grown, especially around pulse signal acquisition and analysis (Tian et al., 2024).

Yet pulse diagnosis also shows the limits of datafication. The tactile phrase often translated as 'clear in the mind but difficult to express under the fingers' captures a form of embodied knowledge that sensors only partially reproduce. AI models may classify waveforms, but the physician must still interpret whether the pulse fits the patient's overall condition. Future pulse systems should therefore combine high-quality sensors with physician feedback, training modules, and interpretable representations of pulse features.

7.3 Integrated Multimodal Diagnostic Platforms

The most promising direction is integrated multimodal diagnosis. Since each of the four diagnostic methods has limitations, TCM relies on their synthesis. An integrated AI platform should combine image, sound, text, pulse, and longitudinal data to generate evidence-weighted

diagnostic hypotheses. It should also explain how each modality contributed to the output and where evidence is insufficient.

Such platforms can be especially useful in primary care, education, and quality control. They may help junior physicians learn from expert cases, reduce missing information in medical records, and support more consistent documentation of pattern differentiation. However, their clinical legitimacy depends on external validation, transparent model governance, and careful preservation of physician authority. AI should strengthen the physician's capacity to see the whole patient, not replace holistic care with fragmented automation.

8. Conclusion

AI diagnostic systems represent an important encounter between traditional medical wisdom and contemporary computational technology. In TCM diagnosis, this encounter is especially significant because the four diagnostic methods are deeply tied to holistic observation, fuzzy categorization, tacit experience, and individualized pattern differentiation. AI can enhance diagnostic consistency, retrieve large-scale knowledge, support education, and improve the objectification of certain diagnostic signs. Yet it can also marginalize experiential judgment, oversimplify holistic reasoning, and create new forms of algorithmic authority.

This paper has argued that the most appropriate path is human-AI collaboration. AI should function as an augmentative instrument that supports data acquisition, pattern retrieval, uncertainty management, and knowledge transmission. Physicians should remain responsible for contextual interpretation, ethical communication, individualized decision-making, and final clinical judgment. The future of AI-TCM should therefore be guided by TCM-informed algorithms, multimodal integration, longitudinal personalization, transparent explanation, and rigorous ethical governance.

The broader significance of this analysis lies in its understanding of knowledge transformation. Modernization should not mean the simple replacement of traditional categories by technological measures, nor should tradition be protected by rejecting all computational tools. Instead, the development of AI-TCM diagnosis should be a reciprocal process: AI can make certain aspects of TCM more explicit, standardized, and evidence-responsive, while TCM's holistic and relational cognition can guide the design of more context-sensitive and human-centered AI systems. In this mutual shaping, the future of TCM diagnosis may become both technologically advanced and faithful to its classical cognitive spirit.

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Distinct Psychological Pathways from Childhood Adversity to Addictive Outcomes in College Students: Parallel Mediating Roles of Internalizing Distress and Externalizing Dysregulation

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Abstract:

This study examined the psychological pathways linking childhood adversity to different addictive outcomes among college students, with a focus on the parallel mediating roles of internalizing distress and externalizing dysregulation. A cross-sectional survey was conducted among 1,198 college students with smoking behavior from universities in Guizhou Province, China. Childhood adversity was assessed through childhood trauma, parental rejection, and parental overprotection; internalizing distress was indicated by depression, anxiety, and stress; externalizing dysregulation was indicated by aggression and poor self-control. Structural equation modeling was used to test two parallel mediation models for internet-related addiction and nicotine dependence. The results showed that childhood adversity significantly and positively predicted both internalizing distress and externalizing dysregulation, whereas its direct effects on internet-related addiction and nicotine dependence were not significant. For nicotine dependence, the pathway through internalizing distress was relatively stronger, and remained significant after controlling for internet-related addiction. For internet-related addiction, externalizing dysregulation was the dominant mediating pathway, while internalizing distress showed a significant negative suppression effect. These findings suggest that although behavioral and substance-related addictive outcomes share childhood adversity as a common distal risk factor, they may be driven by distinct proximal psychological mechanisms. Prevention and intervention programs for college students should therefore emphasize emotion regulation for nicotine dependence and behavioral control for internet-related addiction.

Keywords: childhood adversity; internalizing distress; externalizing dysregulation; internet-related addiction; nicotine dependence; college students

1. Introduction

College students are in a critical developmental period spanning late adolescence and emerging adulthood, during which addictive behaviors may begin to consolidate and intensify. In this population, internet-related addiction and nicotine dependence deserve particular attention. Existing evidence indicates that problematic internet use and problematic computer gaming are not uncommon among undergraduates and are significantly associated with mental health problems such as depression and self-harm, suggesting that they have become important concerns for university mental health services (Stevens et al., 2020). Smoking among college students, although often characterized as light or intermittent, remains associated with nicotine dependence and multiple health risks (Halperin et al., 2010). In addition, smoking behavior in this population has shown stable links with negative affect, which has been identified as one of the most robust correlates of college student smoking (Magid et al., 2009). Accordingly, examining internet-related addiction and nicotine dependence simultaneously, and comparing their shared risk background as well as their potentially distinct psychological mechanisms, is of clear theoretical and practical importance in college student populations.

Childhood adversity has been widely recognized as an important upstream risk factor for a range of addiction-related outcomes. Classic work has shown that adverse childhood experiences are significantly associated with smoking during adolescence and adulthood, with greater adversity exposure corresponding to higher smoking risk (Anda et al., 1999). In the field of internet-related addiction, a recent meta-analysis likewise demonstrated a significant and stable positive association between childhood adverse experiences and internet addiction (Hao et al., 2024). More student-focused evidence further suggests that childhood trauma is moderately and positively associated with problematic internet use among students in mainland China (Wang et al., 2023), and that family-level adverse childhood experiences are related to elevated risks of

problematic internet use and problematic smartphone use in college samples (Forster et al., 2021). Together, these findings suggest that childhood adversity may represent a common upstream risk background for both internet-related addiction and nicotine dependence in college students. However, prior studies have largely focused on the overall association between childhood adversity and a single addictive outcome, whereas direct comparisons of how childhood adversity may influence different types of addiction through distinct psychological pathways remain limited.

Importantly, the present study adopts a relatively broad operationalization of childhood adversity, encompassing not only traumatic experiences but also persistent negative parenting and maladaptive parent-child interaction environments. Parental rejection, as a classic dimension of negative parenting, has consistently been linked to children's and adolescents' internalizing and externalizing problems. For example, Rothenberg et al. (2022) found in a longitudinal multicultural study that perceived parental acceptance-rejection significantly predicted later internalizing and externalizing behaviors. Parental overprotection, although not traditionally classified as a core adverse childhood experience, has also been increasingly recognized as developmentally harmful. Specifically, overprotection reflects excessive involvement, control, and restriction of autonomy, all of which may undermine adaptive development. A systematic review and meta-analysis showed that parental overprotection assessed by the EMBU was stably and positively associated with offspring internalizing and externalizing problems, with maternal overprotection often showing stronger effects than paternal overprotection (de Roo et al., 2022). Related work has further linked overprotection to lower behavioral autonomy, poorer psychosocial adjustment, and frustration of adolescents' psychological needs (Van Petegem et al., 2020; Williams et al., 2002). Because these variables capture relational experiences in early development rather than current college-period states, their theoretical meaning is appropriately

supported by child and adolescent developmental research. Accordingly, the present study includes parental rejection and parental overprotection as observed indicators of childhood adversity in order to more comprehensively capture relational adversity in early life.

From a developmental psychopathology perspective, childhood adversity is unlikely to lead to a single maladaptive outcome. Instead, it may simultaneously activate multiple maladaptive pathways. One pathway is characterized by inwardly directed distress, namely an internalizing pathway involving depression, anxiety, and stress. The other is characterized by behavioral dysregulation, namely an externalizing pathway involving heightened aggression and reduced self-control. In college students, both pathways appear relevant to addiction-related behaviors. Meta-analytic evidence indicates that problematic internet use is stably associated with depression, anxiety, and other mental health problems in student populations (Cai et al., 2023). In university samples, problematic internet use has also been linked with PTSD, depression, and anxiety symptoms (Xie et al., 2021). Moreover, evidence from child and adolescent samples suggests that problematic internet use is associated with a range of psychiatric disorders and functional impairments, including both internalizing and externalizing problems (Restrepo et al., 2020), implying that shared but differentiable mechanisms may underlie this phenomenon. With respect to smoking, negative affect has likewise been shown to be stably related to smoking behavior among college students (Magid et al., 2009). Taken together, internalizing distress and externalizing dysregulation may represent two key psychological pathways through which childhood adversity influences addictive behaviors in college students. Yet previous studies have typically examined internalizing or externalizing problems separately, and relatively few have incorporated both as parallel mechanisms within the same model.

Although internet-related addiction and nicotine dependence can both be conceptualized as addiction-related outcomes, they may not arise through identical psychological processes. In

college students, internet-related addiction is embedded in everyday digital media environments and may therefore be especially closely tied to impulsivity, behavioral disinhibition, and immediate reward seeking. By contrast, nicotine dependence may be more closely linked to emotional distress, internal regulatory needs, and behavioral dysregulation. Direct comparative evidence on these mechanisms in college student samples remains limited. Therefore, comparing internet-related addiction and nicotine dependence may clarify whether childhood adversity affects different addictive outcomes through similar or distinct psychological pathways, and may in turn shed light on the mechanisms differentiating behavioral and substance-related addiction in college students.

In summary, prior research has established robust links between childhood adversity and addictive behaviors, yet direct comparisons of how childhood adversity may affect different addictive outcomes through distinct psychological pathways remain scarce. In particular, few studies have simultaneously examined internalizing distress and externalizing dysregulation as parallel mediators and further tested whether their roles differ across behavioral and substance-related addiction. To address this gap, the present study focused on college students with smoking behavior from universities in Guizhou Province, China, and constructed two parallel mediation structural equation models to examine whether childhood adversity influences internet-related addiction and nicotine dependence through internalizing distress and externalizing dysregulation. In addition, cross-outcome control analyses were conducted to test the specificity of the mechanisms underlying the two addictive outcomes. Based on the existing literature, we proposed that childhood adversity would positively predict both internet-related addiction and nicotine dependence; that childhood adversity would positively predict internalizing distress and externalizing dysregulation; that internalizing distress and externalizing dysregulation would mediate the associations between childhood adversity and the two addictive outcomes; and that

the two mediation pathways might show different patterns across internet-related addiction and nicotine dependence.

2. Method

2.1 Participants and Procedure

This study used a cross-sectional survey design and recruited college students with smoking behavior from universities in Guizhou Province, China. Data were collected online from October to December 2025. A total of 1,350 questionnaires were distributed. After excluding cases with obviously patterned responses and those scoring 0 on both the DSM-5 smoking diagnosis and the nicotine dependence questionnaire, 1,198 valid questionnaires were retained, resulting in an effective response rate of 88.74%.

The final sample included 871 males (72.7%) and 327 females (27.3%), with ages ranging from 16 to 30 years ($M = 20.35$, $SD = 1.46$). Because all questionnaire items were mandatory, there were no missing data. All participants provided informed consent prior to participation. The study was approved by the Ethics Committee of Zunyi Medical University ([Zunyi Ethics Review 2025 No. 3-009]).

2.2 Measures

2.2.1 Childhood Adversity

Childhood adversity was modeled as a latent construct reflected by indicators of childhood trauma and adverse parenting-related experiences. In the present study, childhood adversity was operationalized broadly to include both traumatic experiences and adverse parenting-related experiences during early development.

Childhood trauma was assessed using the Childhood Trauma Questionnaire (CTQ). The CTQ consists of 28 items rated on a 5-point scale (0 = never to 4 = always) and assesses five dimensions of childhood trauma, including emotional abuse, physical abuse, sexual abuse, emotional neglect, and physical neglect. The scale also includes validity items for detecting minimization/denial responses (Bernstein et al., 1994). In the present study, the CTQ demonstrated high internal consistency ($\alpha = 0.898$).

Parenting-related experiences were assessed using a short-form version of the Egna Minnen av Barndoms Uppfostran (EMBU) (Perris et al., 1980). Four subscale scores were selected as observed indicators, including father overprotection (FOP), father rejection (FR), mother overprotection (MOP), and mother rejection (MR). The internal consistency coefficients for these four indicators were 0.667, 0.859, 0.713, and 0.841, respectively. In the structural models, CTQ, FOP, FR, MOP, and MR were specified as observed indicators of childhood adversity.

2.2.2 Internalizing Distress

Internalizing distress was modeled as a latent construct reflected by three observed indicators: depression (DEP), anxiety (ANX), and stress (STR). These indicators were assessed using the Depression Anxiety Stress Scales-21 (DASS-21), which includes 21 items rated on a 4-point scale (0 = did not apply to me at all to 3 = applied to me very much or most of the time) (Lovibond & Lovibond, 1995). In the present study, the internal consistency coefficients were 0.857 for DEP, 0.837 for ANX, and 0.861 for STR.

2.2.3 Externalizing Dysregulation

Externalizing dysregulation was modeled as a latent construct reflected by aggression (AGG) and reverse-scored self-control (RSC). Aggression was assessed using the Buss-Perry Aggression Questionnaire (BPAQ), a 22-item measure rated on a 5-point Likert scale, with higher scores

indicating greater aggression (Buss & Perry, 1992). Internal consistency was excellent ($\alpha = 0.923$). Self-control was assessed using the 19-item Self-Control Scale, rated on a 5-point scale (Tangney et al., 2004). In the present study, the scale was reverse scored so that higher scores indicated poorer self-control. The internal consistency coefficient of RSC was 0.867.

2.2.4 Internet-Related Addiction

Internet-related addiction was modeled as a latent construct reflected by symptoms of internet gaming disorder and generalized internet addiction. Internet gaming disorder was assessed using the Internet Gaming Disorder Scale-Short Form (IGDS9-SF). This 9-item scale is rated on a 5-point Likert scale, with higher scores indicating more severe internet gaming disorder symptoms (Petry et al., 2014). Internal consistency in the present study was 0.898. Generalized internet addiction was assessed using the Internet Addiction Test (IAT), a 20-item measure rated on a 5-point Likert scale, with higher scores indicating more severe problematic internet use (Young, 1998). Internal consistency in the present study was 0.938. In the structural models, these two indicators were labeled IGD and IA, respectively.

2.2.5 Nicotine Dependence

Nicotine dependence was assessed using the Fagerstrom Test for Nicotine Dependence (FTND), a 6-item measure yielding a total score from 0 to 10, with higher scores indicating more severe nicotine dependence (Heatherton et al., 1991). Following conventional cutoffs, scores of 0-3 indicate mild dependence, 4-6 indicate moderate dependence, and scores of 7 or above indicate severe dependence. Internal consistency in the present study was acceptable ($\alpha = 0.637$). FTND served as the observed indicator of nicotine dependence in the structural model.

2.3 Covariates

Gender, age, and only-child status were included as covariates. Gender was coded as 1 = male and 2 = female. Age was recorded in years. Only-child status was coded as 1 = yes and 2 = no. In the extended models, these variables were included as covariates to examine the robustness of the core pathways after controlling for demographic characteristics.

2.4 Data Preprocessing and Common Method Bias

Because the survey was administered online and all items were mandatory, no missing data were present in the final dataset. Descriptive statistics and correlations among the core variables were first examined.

Given that all data were collected through self-report measures, Harman's single-factor test was used to assess the potential influence of common method bias. All measurement items were entered simultaneously into an unrotated exploratory factor analysis. Common method bias was considered unlikely to be a serious concern if the first unrotated factor accounted for less than the conventional cutoff proportion of variance.

2.5 Statistical Analyses

All statistical analyses were conducted using SPSS 26.0 and Mplus 8.3. First, descriptive statistics and correlation analyses were performed to examine the basic associations among the core variables. Second, the measurement model was evaluated by examining standardized factor loadings, composite reliability (CR), and average variance extracted (AVE) in order to assess convergent and discriminant validity.

After establishing an acceptable measurement model, structural equation modeling was conducted to test whether childhood adversity was associated with internet-related addiction and nicotine dependence via internalizing distress and externalizing dysregulation. Internalizing

distress and externalizing dysregulation were specified as two parallel mediators. Although the two mediators were allowed to correlate, no direct path was specified between them. Thus, the model focused on two parallel psychological pathways rather than a serial mediation process.

Model fit was evaluated using the chi-square to degrees of freedom ratio (χ^2/df), the comparative fit index (CFI), the Tucker-Lewis index (TLI), the root mean square error of approximation (RMSEA), and the standardized root mean square residual (SRMR). To test the significance of mediation effects, 5,000 bootstrap samples were used to estimate total effects, direct effects, total indirect effects, and specific indirect effects. Mediation effects were considered significant when the 95% confidence interval did not include zero.

Finally, cross-outcome control analyses were conducted to examine the specificity of the proposed mechanisms. Specifically, nicotine dependence was controlled in the internet-related addiction model, and internet-related addiction was controlled in the nicotine dependence model, in order to test whether the core pathways remained stable after accounting for comorbid addictive outcomes.

3. Results

3.1 Preliminary Analyses

3.1.1 Common Method Bias

Because all data in the present study were obtained through self-report, Harman's single-factor test was first conducted prior to structural equation modeling. The results indicated that 27 factors had eigenvalues greater than 1, and the first unrotated factor accounted for 19.91% of the total variance, which was below the conventional 40% cutoff. These findings suggest that serious common method bias was unlikely to be present and that the data were suitable for subsequent analyses.

3.1.2 Descriptive Statistics, Correlations, and Discriminant Validity

Table 1 presents the descriptive statistics, bivariate correlations, and discriminant validity results for the core variables. Childhood adversity was positively correlated with internalizing distress, externalizing dysregulation, internet-related addiction, and nicotine dependence. Internalizing distress was positively correlated with externalizing dysregulation and with both addictive outcomes. Externalizing dysregulation showed a stronger correlation with internet-related addiction than with nicotine dependence. Overall, the observed pattern was consistent with theoretical expectations. In addition, the square roots of the AVEs shown on the diagonal exceeded the corresponding interconstruct correlations, supporting adequate discriminant validity among the latent constructs.

Table 1. Descriptive statistics, correlations, and discriminant validity of the core variables.

Variable	M	SD	1	2	3	4	5
1. CA	107.50	24.93	(0.719)				
2. ID	74.94	23.52	0.525**	(0.913)			
3. ED	95.73	22.50	0.412**	0.631**	(0.756-0.761)		
4. IRA	72.34	19.10	0.319**	0.412**	0.549**	(0.805)	-
5. ND	2.85	2.28	0.228**	0.320**	0.249**	-	(1.000)

Note. Values in parentheses on the diagonal are the square roots of the AVEs. Off-diagonal entries are Pearson correlation coefficients. Because the square root of the AVE for ED differed slightly across the two models, it is presented as a range. IRA and ND served as outcomes in two

separate structural models; therefore, their correlation was not reported. CA = childhood adversity; ID = internalizing distress; ED = externalizing dysregulation; IRA = internet-related addiction; ND = nicotine dependence. ** $p < 0.01$.

3.2 Measurement Model Evaluation

Tables 2 and 3 report the measurement properties of the internet-related addiction model and the nicotine dependence model, respectively. Across both models, the standardized factor loadings were acceptable, and all CR and AVE values of the latent constructs met or exceeded commonly used thresholds. Childhood adversity, internalizing distress, and externalizing dysregulation all demonstrated satisfactory convergent validity and internal consistency. In the nicotine dependence model, FTND was specified as a single-indicator outcome.

Table 2. Measurement properties of the internet-related addiction model.

Construct	Indicator	λ	CR	AVE	α
Childhood adversity	CTQ	0.741	0.839	0.517	0.898
	FR	0.870			0.859
	MR	0.790			0.841
	FOP	0.603			0.667
	MOP	0.540			0.713
Internalizing distress	STR	0.922	0.938	0.834	0.861
	ANX	0.924			0.837

	DEP	0.893			0.857
Externalizing dysregulation	RSC	0.745	0.727	0.572	0.867
	AGG	0.767			0.923
Internet- related addiction	IGD	0.704	0.784	0.648	0.898
	IA	0.895			0.938

Table 3. Measurement properties of the nicotine dependence model.

Construct	Indicator	λ	CR	AVE	α
Childhood adversity	CTQ	0.741	0.839	0.517	0.898
	FR	0.871			0.859
	MR	0.790			0.841
	FOP	0.603			0.667
	MOP	0.540			0.713
Internalizing	STR	0.921	0.938	0.834	0.861

distress					
	ANX	0.925			0.837
	DEP	0.893			0.857
Externalizing dysregulation	RSC	0.702	0.732	0.579	0.867
	AGG	0.815			0.923
Nicotine dependence	FTND	1.000	1.000	1.000	0.637

3.3 Structural Model Fit

Table 4 presents the global fit indices of the two structural models. The nicotine dependence model yielded CFI = 0.965, TLI = 0.950, RMSEA = 0.064, and SRMR = 0.036, whereas the internet-related addiction model yielded CFI = 0.961, TLI = 0.946, RMSEA = 0.066, and SRMR = 0.040. Although the chi-square statistics were significant, the overall pattern of descriptive fit indices indicated acceptable model fit in both models, supporting further interpretation of the structural paths.

Table 4. Global fit indices of the structural equation models.

Model	χ^2	df	χ^2/df	CFI	TLI	RMSEA [95% CI]	SRMR
Internet- related addiction	457.959***	74	6.19	0.961	0.946	0.066 [0.060, 0.072]	0.040

model							
Nicotine						0.064	
dependence	368.723***	62	5.95	0.965	0.950	[0.058,	0.036
model						0.071]	

Note:***p<0.001

3.4 Structural Path Estimates

Table 5 presents the standardized structural path coefficients for the two models. In both models, CA significantly and positively predicted ID and ED, indicating that greater adversity was associated with more severe internalizing and externalizing problems. In the ND model, both ID and ED significantly and positively predicted the outcome, whereas the direct path from CA to ND was not significant. In the IRA model, ED significantly and positively predicted the outcome, whereas ID showed a significant negative path. The direct path from CA to IRA was likewise nonsignificant. Overall, the two models were similar in the antecedent paths but differed substantially in the downstream paths leading to the two addictive outcomes.

Table 5. Standardized structural path coefficients for the two models.

Path	IRA β	p	ND β	p
CA $\rightarrow$ ID	0.577***	< 0.001	0.577***	< 0.001
CA $\rightarrow$ ED	0.505***	< 0.001	0.511***	< 0.001
ID $\rightarrow$ outcome	-0.206*	0.004	0.211*	< 0.001
ED $\rightarrow$ outcome	0.818*	<0 .001	0.137*	0.025

CA → outcome	0.074	0.087	0.031	0.398
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Note: *p<0.05, **p<0.01, ***p<0.001

In the internet-related addiction model, externalizing dysregulation showed a strong positive association with the outcome ($\beta = 0.818, p < 0.001$), whereas internalizing distress showed a significant negative association ($\beta = -0.206, p = 0.004$). The direct path from childhood adversity to internet-related addiction was not significant ($\beta = 0.074, p = 0.087$), suggesting that the association between adversity and internet-related addiction was primarily transmitted through the mediators. The final internet-related addiction model is shown in Figure 1.

[Insert Figure 1 about here]

Figure 1. Final standardized path model for the internet-related addiction outcome.

In the nicotine dependence model, both internalizing distress ($\beta = 0.211, p < 0.001$) and externalizing dysregulation ($\beta = 0.137, p = 0.025$) positively predicted nicotine dependence, with the internalizing pathway showing the larger coefficient. The direct path from childhood adversity to nicotine dependence was not significant ($\beta = 0.031, p = 0.398$), again suggesting primarily indirect transmission of effects. The final nicotine dependence model is shown in Figure 2.

[Insert Figure 2 about here]

Figure 2. Final standardized path model for the nicotine dependence outcome.

3.5 Bootstrap Decomposition of Mediation Effects

Table 6 reports the bootstrap estimates of total effects, direct effects, total indirect effects, and specific indirect pathways. In the nicotine dependence model, the total effect was significant, the direct effect was not significant, and the total indirect effect was significant, indicating that the

association between childhood adversity and nicotine dependence was primarily mediated.

Among the specific indirect effects, the pathway through internalizing distress was larger than the pathway through externalizing dysregulation. In the internet-related addiction model, the total effect and the total indirect effect were likewise significant, whereas the direct effect was not significant. Notably, the indirect effect through externalizing dysregulation was strongly positive, whereas the indirect effect through internalizing distress was significantly negative.

Table 6. Bootstrap decomposition of total, direct, and indirect effects.

Model	Effect	β	95% CI
IRA	Total effect	0.368***	[0.302, 0.431]
IRA	Direct effect	0.074	[-0.012, 0.157]
IRA	Total indirect effect	0.294*	[0.229, 0.363]
	Adversity →		
IRA	Internalizing →	-0.119**	[-0.207, -0.044]
	Outcome		
	Adversity →		
IRA	Externalizing →	0.413***	[0.333, 0.508]
	Outcome		
ND	Total effect	0.223***	[0.163, 0.281]
ND	Direct effect	0.031	[-0.043, 0.104]
ND	Total indirect effect	0.192*	[0.149, 0.237]
	Adversity →		
ND	Internalizing →	0.122***	[0.057, 0.186]

	Outcome		
	Adversity →		
ND	Externalizing →	0.070*	[0.010, 0.134]
	Outcome		

Note: *p<0.05, **p<0.01, ***p<0.001

3.6 Specificity Analyses After Controlling for Comorbidity

Table 7 presents the specificity tests after controlling for the other addictive outcome. In the nicotine dependence model, after controlling for internet-related addiction, the adversity → internalizing distress → nicotine dependence pathway remained significant, whereas the adversity → externalizing dysregulation → nicotine dependence pathway became nonsignificant, suggesting that the internalizing pathway showed greater specificity. By contrast, in the internet-related addiction model, after controlling for nicotine dependence, both the adversity → externalizing dysregulation → internet-related addiction pathway and the adversity → internalizing distress → internet-related addiction pathway remained significant, indicating that the core mediation paths in the internet-related addiction model were robust to comorbidity adjustment.

Table 7. Specificity tests after controlling for the other addictive outcome.

Model	Indirect path	Original β	Adjusted β
IRA model	CA → ED → outcome	0.413***	0.346***
	CA → ID → outcome	-0.119**	-0.118***
ND model	CA → ID → outcome	0.122***	0.018**
	CA → ED → outcome	0.070*	0.006 (ns)

Note: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

4. Discussion

The present study used two parallel mediation structural equation models in a sample of college students with smoking behavior from Guizhou Province, China, to compare the psychological pathways through which childhood adversity was associated with nicotine dependence and internet-related addiction via internalizing distress and externalizing dysregulation. Three main findings emerged. First, in both models, childhood adversity significantly and positively predicted internalizing distress and externalizing dysregulation, whereas the direct paths from childhood adversity to the addictive outcomes were not significant. This pattern suggests that the association between early adversity and addiction risk was transmitted primarily through emotional and behavioral maladjustment rather than through significant direct effects in the present models. Second, although the two addictive outcomes shared similar antecedent pathways, their downstream pathways diverged: nicotine dependence was showed a stronger effect-size trend to the pathway through internalizing distress, whereas internet-related addiction was more strongly driven by externalizing dysregulation, with internalizing distress showing a significant negative suppression pattern in the internet-related addiction model. Third, the cross-outcome control analyses indicated that these pathway differences remained relatively stable after controlling for the other addictive outcome. Overall, the findings suggest that although substance-related and behavioral addictive outcomes may share a common early risk background, their psychological mechanisms are not identical (Cicchetti & Rogosch, 1996).

4.1 Childhood adversity as a common upstream predictor of internalizing distress and externalizing dysregulation

Across both models, childhood adversity showed moderate-to-strong and similarly directed positive associations with both internalizing distress ($\beta = 0.577$) and externalizing dysregulation ($\beta = 0.505\text{--}0.511$), whereas the direct paths from childhood adversity to the addictive outcomes were not significant. This pattern is broadly consistent with the developmental psychopathology perspective of multifinality, according to which a single upstream risk factor may contribute to different maladaptive outcomes through distinct developmental or psychological pathways (Cicchetti & Rogosch, 1996).

In the present study, childhood adversity was conceptualized as a broad construct including both childhood traumatic experiences and adverse relational experiences in the family context. This operationalization extends beyond the traditional ACE framework (Felitti et al., 1998) by also incorporating relational adversity dimensions—specifically, parental rejection and parental overprotection—that may shape later psychological adjustment but are not always captured in conventional ACE inventories.

Moreover, the nonsignificant direct paths and significant total indirect effects in both models indicate that internalizing distress and externalizing dysregulation jointly accounted for the major mediating processes linking childhood adversity to both nicotine dependence and internet-related addiction. This pattern reinforces the importance of focusing on how early adversity becomes translated into later risk, rather than asking only whether adversity has a direct effect on addictive outcomes.

4.2 Nicotine dependence model: the relatively stronger role of internalizing distress

In the nicotine dependence model, both internalizing distress and externalizing dysregulation positively predicted nicotine dependence, but the specific indirect effect through internalizing distress ($\beta = 0.122$) was larger than that through externalizing dysregulation ($\beta = 0.070$). This suggests that, in the pathway from childhood adversity to nicotine dependence, internal distress characterized by depression, anxiety, and stress may play a relatively more prominent mediating role.

This interpretation is directionally consistent with prior college-student research showing that negative affect is an important correlate of smoking behavior. Magid et al. (2009) found that negative affect was the most robust correlate of smoking among college students, even after accounting for alcohol and marijuana use. In light of the present findings, this suggests that among college students exposed to higher levels of childhood adversity, internal distress may play a particularly salient role in the development of nicotine dependence risk. At the same time, because the present study did not directly assess smoking motives, these results are more appropriately interpreted as reflecting a risk transmission pattern associated with internalizing distress rather than as direct evidence for any specific motivational mechanism of smoking.

The cross-outcome control analyses provide a more refined interpretation. After additionally controlling for internet-related addiction, the indirect effect through internalizing distress remained significant, whereas the indirect effect through externalizing dysregulation became nonsignificant. This pattern suggests that the association between externalizing dysregulation and nicotine dependence may partially overlap with comorbid risk related to internet-related addiction, whereas the link between internalizing distress and nicotine dependence appears more stable. More broadly, this interpretation is compatible with addiction models that emphasize the role of negative affect and negative reinforcement in substance-related dependence (Baker et al., 2004).

4.3 Internet-related addiction model: the dominant role of externalizing dysregulation and the suppression pattern of internalizing distress

In the internet-related addiction model, externalizing dysregulation showed a comparatively strong association with the outcome ($\beta = 0.818$, $p < 0.001$), and the specific indirect effect through externalizing dysregulation ($\beta = 0.413$) was substantially larger than the corresponding effect in the nicotine dependence model ($\beta = 0.070$). This suggests that, in the present sample, behavioral disinhibition—primarily reflected in higher aggression and poorer self-control—may represent the core psychological pathway through which childhood adversity was associated with internet-related addiction.

This pattern is broadly consistent with the I-PACE model, which proposes that addictive online behaviors develop through interactions among personal predispositions, affective-cognitive responses, and executive control processes, with deficits in inhibitory control playing an important role in the shift from habitual to dysregulated use (Brand et al., 2019). In the present study, externalizing dysregulation was indicated by aggression and poor self-control, both of which correspond closely to the central features of behavioral disinhibition and impaired executive control. Accordingly, the current findings are consistent with the possibility that, in the digital media environment of college students, deficits in behavioral control may more contribute to the risk of internet-related addiction than internal distress alone.

At the same time, one of the most notable findings of this study is that internalizing distress showed a significant negative path coefficient in the internet-related addiction model ($\beta = -0.206$, $p = 0.004$), and the specific indirect effect through internalizing distress was also negative ($\beta = -0.119$, 95% CI $[-0.207, -0.044]$). Because this indirect effect was opposite in direction to the externalizing pathway and the overall indirect pattern, it suggests a negative suppression effect. As MacKinnon et al. (2000) argued, suppression may occur when adding a third variable changes

the magnitude or direction of the relation between an independent and a dependent variable by reallocating shared variance. In the present context, this means that the negative path from internalizing distress to internet-related addiction is more appropriately understood as a unique residual effect after accounting for externalizing dysregulation, rather than as evidence that internalizing distress generally protects against internet-related addiction .

This interpretation is important because the zero-order association between internalizing distress and internet-related addiction was positive($r = 0.412$, $p < 0.01$), which is consistent with the broader literature showing that problematic internet use is generally positively associated with depression, anxiety, loneliness, and other adverse mental health outcomes (Cai et al., 2023). The current negative path emerged only after internalizing distress and externalizing dysregulation were modeled simultaneously, and after the shared variance between the two mediators was statistically separated. Thus, the present findings do not suggest that internalizing distress is beneficial. Rather, they indicate that once the variance shared with externalizing dysregulation is accounted for, the remaining unique component of internalizing distress may be associated with a lower tendency toward highly stimulating, strongly interactive, and immediate-feedback-oriented internet-related addictive behaviors .

Empirical work suggests that such a pattern is not entirely without precedent. Zhou et al. (2024) reported a suppression effect in adolescent internet addiction research, showing that direct effects and indirect effects through well-being could operate in opposite directions within the same model. In addition, broader developmental psychopathology research has shown that, after controlling for externalizing psychopathology and depression, the unique effects of internalizing or anxiety symptoms may sometimes become negative rather than positive. Specifically, Rieselbach et al. (2023) found that after controlling for externalizing psychopathology and depression, anxiety was associated with reduced substance use in adolescence. Taken together,

these findings support a cautious interpretation of the present result: after controlling for externalizing dysregulation, the remaining unique variance of internalizing distress may be more strongly associated with withdrawal, avoidance, inhibition, or disengagement, characteristics that may not facilitate internet-related addictive behaviors.

On this basis, the most defensible conclusion is that internalizing distress functioned as a negative suppressor in the internet-related addiction model. At the same time, this interpretation should be regarded as provisional, given the cross-sectional design and the broader literature documenting an overall positive association between internalizing symptoms and problematic internet use.

4.4 Pathway heterogeneity and differentiation between nicotine dependence and internet-related addiction

When the two models are considered together, a consistent pattern emerges: childhood adversity, as a common upstream risk factor, was associated with different addictive outcomes through two parallel pathways—internalizing distress and externalizing dysregulation—but the relative salience of these pathways differed across outcomes.

More specifically, nicotine dependence was more closely associated with the pathway through internalizing distress—characterized by depression, anxiety, and stress—consistent with an affect-regulation-related risk pattern. By contrast, internet-related addiction was more closely associated with the pathway through externalizing dysregulation—characterized by aggression and poor self-control—consistent with an impulse-control-related risk pattern. This differentiation aligns with longstanding theoretical distinctions in addiction science: substance-related dependence has been linked primarily to negative reinforcement and the regulation of negative affect (Baker et al., 2004), whereas behavioral addictive outcomes have been linked

more closely to deficits in inhibitory control and reward-driven decision-making (Brand et al., 2019).

The cross-outcome control analyses provided further, albeit indirect, support for this differentiation. In the nicotine dependence model, the indirect effect through externalizing dysregulation was no longer significant after controlling for internet-related addiction, whereas the indirect effect through internalizing distress remained significant. In the internet-related addiction model, both the externalizing pathway and the negative internalizing suppression pathway remained stable after controlling for nicotine dependence. These results suggest that, although the two addictive outcomes may co-occur, their proximal psychological pathways may not be identical. This interpretation is also consistent with evidence that the role of internalizing symptoms in addiction-related outcomes can vary depending on whether co-occurring externalizing psychopathology is taken into account (Rieselbach et al., 2023). It should be noted, however, that cross-outcome control analyses represent statistical adjustment rather than causal decomposition; the observed pattern therefore provides convergent but not conclusive evidence for pathway specificity.

4.5 Theoretical contributions and practical implications

The present study contributes to the existing literature in several ways. First, whereas previous research has typically examined internalizing and externalizing problems in isolation, the present study incorporated both into a single parallel mediation framework, revealing their differentiated mediating roles across two addictive outcomes. Second, by simultaneously examining nicotine dependence and internet-related addiction within the same sample, the study enabled a direct within-sample comparison of the psychological pathways underlying a substance-related and a behavioral addictive outcome. Third, the inclusion of cross-outcome control analyses allowed us to test whether the observed mediation patterns remained stable after

accounting for comorbid addictive risk, thereby providing convergent evidence for a pattern of shared upstream risk but differentiated downstream pathways. Fourth, the identification of a negative suppression effect of internalizing distress in the internet-related addiction model underscores the importance of attending to shared variance, competing pathways, and potential direction reversals when conducting parallel mediation analyses.

Several practical implications follow from these findings, though they should be considered preliminary given the cross-sectional nature of the data. Prevention efforts targeting college students may benefit from greater attention to childhood adversity as a distal source of risk for multiple addictive outcomes. For students at elevated risk of nicotine dependence, intervention strategies that prioritize emotion regulation and the alleviation of internalizing symptoms may be particularly relevant. For those at elevated risk of internet-related addiction, interventions targeting behavioral control—such as self-control training and impulsivity management—may warrant greater emphasis. Because the two addictive outcomes may co-occur, comprehensive prevention programs should ideally address both emotion regulation and behavioral control, with the relative emphasis tailored to the individual's dominant risk profile. These implications are consistent with the distinct pathway patterns observed in the present models and with prior theoretical work on negative reinforcement in substance dependence and executive-control deficits in behavioral addiction .

4.6 Limitations and future directions

Several limitations should be acknowledged. First, the study employed a cross-sectional design, and all variables were measured at the same time point. Although childhood adversity theoretically precedes current psychological symptoms and addictive behaviors, the causal ordering among internalizing distress, externalizing dysregulation, and the addictive outcomes cannot be established with certainty. Future research should adopt longitudinal or cross-lagged

designs to clarify temporal ordering. Second, the sample was limited to college students with smoking behavior from universities in Guizhou Province, and the proportion of male participants was relatively high. Therefore, the generalizability of the findings to other regions, female samples, and non-smoking college student populations remains to be established. Third, all variables were assessed via self-report, which may have introduced recall bias and social desirability bias. Fourth, nicotine dependence was modeled using FTND as a single indicator with the factor loading fixed at 1, which may have limited the precision of measurement error correction and latent variable estimation. Finally, the χ^2/df values were slightly above conventional heuristic thresholds. Although alternative fit indices such as CFI, RMSEA, and SRMR fell within acceptable ranges, model fit should still be interpreted with appropriate caution .

5. Conclusion

Based on a sample of 1,198 college students with smoking behavior, the present study used dual parallel mediation structural equation models to reveal differentiated psychological mechanisms through which childhood adversity was associated with nicotine dependence and internet-related addiction. The findings indicate that childhood adversity primarily affected the two addictive outcomes indirectly through parallel pathways involving internalizing distress and externalizing dysregulation, rather than through stable direct effects. In the nicotine dependence model, internalizing distress emerged as the relatively more important pathway. In the internet-related addiction model, externalizing dysregulation was the stronger driving pathway, whereas internalizing distress showed a negative suppression pattern. These findings suggest that although substance-related and behavioral addictive outcomes share common early risk backgrounds, they differ meaningfully in their psychological mechanisms. Future prevention and intervention efforts

may therefore benefit from adopting more targeted strategies based on the distinct mechanisms underlying different addictive outcomes (MacKinnon et al., 2000; Brand et al., 2019).

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**Project-Driven Teaching Reform Based on Real Enterprise Projects in
Applied Undergraduate Education**

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Abstract

Objective: To examine the effectiveness of a project-driven teaching reform model based on real enterprise projects in applied undergraduate education. **Methods:** Based on a school-enterprise collaboration project, this study developed an integrated “course-project-training-evaluation” teaching model and embedded real enterprise tasks into the teaching process. The reform included course content reconstruction, project task design, teaching organization optimization, and the establishment of a multiple evaluation mechanism. **Results:** The reform improved students’ learning engagement, practical application ability, and job adaptability awareness, and promoted the shift from knowledge-based teaching to task-driven and practice-oriented learning. **Conclusion:** The model helped enhance teaching effectiveness and strengthen the link between curriculum teaching and enterprise needs, providing a useful reference for applied undergraduate institutions seeking to advance school-enterprise collaborative education and curriculum reform.

Key words: project-driven teaching reform; real enterprise projects; school-enterprise collaboration; industry-education integration; applied undergraduate education

1 Introduction

Against the backdrop of digital transformation and industrial upgrading, enterprises increasingly demand application-oriented, interdisciplinary, and practice-ready talents (Chen et al.,2025). This trend requires universities to shift from knowledge transmission to competence development and from subject-centered instruction to more integrated learning experiences (Rodrigo, 2017). However, many applied undergraduate courses still suffer from outdated content, weak practical training, fragmented teaching tasks, and limited evaluation methods, making it difficult to effectively support students’ job-related competence (Okolie et al.,2020).

The problem is particularly evident in interdisciplinary courses involving data analysis, artificial intelligence applications, human resource management, and enterprise decision support, where students often remain at the level of conceptual understanding and lack opportunities to connect knowledge with authentic work tasks. As a result, students may complete a course with acceptable exam results while still lacking confidence in dealing with real workplace problems, collaborative project tasks, and data-supported decision making. In applied undergraduate education, such a gap directly affects the quality of talent cultivation and weakens the relevance of the curriculum to industry needs.

In response, this study integrates real enterprise problems, development tasks, and practical scenarios into classroom teaching through a school-enterprise collaboration project and explores a project-driven approach to teaching reform. The selected project focuses on an intelligent talent matching system and provides a relatively complete chain of practical tasks, including job demand identification, information extraction, relationship structuring, matching logic design, iterative optimization, and achievement presentation. Compared with simulated cases written solely for classroom use, a real enterprise project offers stronger authenticity, clearer task orientation, and more direct links to job competence. It therefore creates favorable conditions for integrating course content, project practice, practical training, and evaluation. On this basis, the present study aims to answer a practical educational question: how can a real enterprise project be transformed into a sustainable teaching carrier, and how can such transformation help applied undergraduate education move from knowledge-based teaching to competence-oriented learning?

2 Practical Foundation and Problem Analysis of the Teaching Reform

2.1 Project Foundation

This teaching reform is based on a real enterprise project and stable school-enterprise collaboration, with clear problem orientation and solid practical conditions. Although the partner enterprise has established a relatively mature recruitment system, it still faces such problems as imprecise identification of job demand, insufficient efficiency in talent matching, and relatively high pressure in talent turnover. The intelligent talent matching project responds directly to these practical needs in human resource management and job fit. Compared with conventional classroom content, this type of project provides authentic scenarios, integrated tasks, and complex problem structures, all of which are conducive to curriculum reform. In addition, earlier collaboration between the university and the enterprise, as well as related research and case analysis conducted by the teaching team, created a practical basis for transforming real enterprise tasks into teaching tasks. This foundation is important because project-driven reform cannot rely on abstract teaching ideas alone; it requires access to real problems, institutional support, and a stable practice platform. The project examined in this study offered these conditions and therefore provided a realistic starting point for curriculum reform.

2.2 Current Problems in Teaching

Current teaching does not connect closely enough with enterprise job requirements. Students' learning of such content as knowledge graphs, intelligent recommendation, and job analysis often remains at the level of concepts, definitions, and isolated classroom examples, with limited opportunities for integrated application in authentic project contexts. At the same time, classroom teaching still relies heavily on teacher explanation, while task-driven learning and project practice remain relatively insufficient. This weakens students' development in problem diagnosis, scheme design, teamwork, communication, and transfer of knowledge to practice. In terms of evaluation, many courses still depend primarily on final or result-oriented assessment.

Less attention is given to process performance, project participation, practical output, and reflective improvement, making it difficult to comprehensively capture students' competence development in real task situations. These problems reveal that curriculum reform in applied undergraduate education should not only add new content, but also redesign the teaching process, learning tasks, and evaluation logic.

2.3 Necessity of the Teaching Reform

In the context of cultivating application-oriented undergraduate talents, curriculum reform should not remain at the level of updating knowledge content alone, but should place greater emphasis on competence development, practical transfer, and job adaptability. Real enterprise projects make such reform especially necessary because they can embed classroom learning in authentic work situations, allowing students to experience the full process of problem analysis, task decomposition, scheme design, collaborative implementation, and outcome presentation. This process helps students move from “knowing” to “doing,” and from isolated knowledge acquisition to integrated competence generation. It also helps teachers redesign teaching around what students should be able to perform, rather than only what they should remember. Therefore, project-driven reform based on real enterprise tasks has clear practical necessity in improving the relevance, applicability, and effectiveness of curriculum teaching and in promoting the transformation from knowledge-based teaching to task-driven and practice-oriented learning.

3 Objectives and Overall Approach of the Teaching Reform

3.1 Reform Objectives

This reform is oriented toward the cultivation of application-oriented undergraduate talents and aims to promote the transformation of teaching from knowledge transmission to competence

development and literacy enhancement. At the knowledge level, it helps students understand the concepts and application logic of knowledge graphs, attention mechanisms, job demand forecasting, and talent matching. At the ability level, it focuses on cultivating students' data processing ability, project analysis ability, interdisciplinary integration ability, teamwork ability, and problem-solving ability. At the literacy level, it enhances students' job awareness, innovation awareness, and career development awareness, thereby improving the practical value and educational effectiveness of the course.

3.2 Overall Approach

This reform takes a real enterprise project as the driving force and the development tasks of job demand forecasting and talent matching system as the main line, and constructs an overall framework of “course content reconstruction - project task embedding - practice platform support - multiple evaluation and feedback.” By transforming real enterprise needs, key tasks, and practical processes into course task chains, the reform integrates knowledge learning, project practice, and competence development, and promotes the alignment of course content with job requirements, the integration of teaching with project practice, and the connection of evaluation with competence development.

3.3 Theoretical Basis

The reform is informed by several complementary educational perspectives. First, constructive alignment emphasizes that learning outcomes, teaching activities, and assessment tasks should be aligned so that students are consistently guided toward meaningful competence development (Hristov et al., 2023; Biggs & Tang, 2011; Biggs, 1996). This idea supports the present reform because the course does not simply introduce enterprise cases as supplementary materials; rather,

it reconstructs teaching content, tasks, and evaluation around a shared project objective. Second, experiential learning highlights that effective learning develops through concrete experience, reflective observation, abstract conceptualization, and active experimentation (Morris, 2020; Kolb, 1984). A real enterprise project provides exactly such a cycle: students encounter practical problems, reflect on them, connect them with course concepts, and test their understanding through project outputs. Third, project-based and problem-based learning research shows that students' higher-order thinking, collaboration, and transfer of learning can be strengthened when knowledge is organized around complex, meaningful tasks rather than fragmented exercises (Thomas, 2000; Hmelo-Silver, 2004; Prince & Felder, 2006). Finally, authentic assessment theory suggests that evaluation is more educationally meaningful when students demonstrate competence through tasks that resemble real professional practice (Gulikers et al., 2004). These perspectives jointly support the use of a real enterprise project as the carrier of teaching reform. They also justify the integrated design of course content reconstruction, project task chains, school-enterprise collaborative practice, and multiple evaluation mechanisms in the current study.

To strengthen the connection between curriculum teaching and real enterprise tasks, this study reconstructed the original course content into modular units based on the Intelligent Talent Matching System project. The course content was reorganized into six modules: job demand analysis and project scenario cognition, knowledge graph fundamentals and structured job information processing, attention mechanism and key feature identification, job demand forecasting and talent matching logic, system optimization and feedback evaluation, and project reporting and outcome presentation. These modules correspond to the project flow from demand identification and information processing to scheme design, optimization, and feedback, while also matching students' learning progression from conceptual understanding to practical

application. Such modular reconstruction helps avoid the common problem of fragmented knowledge delivery in traditional teaching. Instead of treating concepts as isolated points, the course links them through a coherent project logic, enabling students to understand not only what each concept means but also where and why it is used. In this way, course knowledge becomes more contextualized, integrated, and usable.

4.1 Reconstructing the Course Content System

On the basis of modular course reconstruction, this study further decomposed the development process of the real enterprise project into a progressive project task chain. The tasks included analyzing enterprise job demands and talent pain points, extracting key entities from job descriptions and résumés, constructing a preliminary job-skill relationship graph, designing matching logic and recommendation rules, completing a system prototype or project scheme, and conducting project reporting, defense, and reflective optimization. The task chain was arranged according to teaching weeks and learning progression so that students could gradually move from problem awareness to data handling, logical design, practical demonstration, and reflective improvement. Transforming a complex enterprise project into staged and executable learning tasks reduced the difficulty of participation, especially for students who had limited prior experience with interdisciplinary project work. More importantly, it provided a stable structure for classroom teaching, group collaboration, formative feedback, and process evaluation. The project task chain therefore served not only as a teaching arrangement, but also as the core mechanism linking knowledge learning, competence training, and outcome generation.

Table 1 Teaching Module Design and Competency Development Framework

Teaching Module	Main Content	Main Competence Focus
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Teaching Module	Main Content	Main Competence Focus
Module 1: Job Demand Analysis and Project Scenario Cognition	Enterprise needs, job background, project task understanding	Problem awareness; job awareness
Module 2: Knowledge Graph Fundamentals and Structured Job Information	Structured processing of job, skill, and talent information	Information integration ability
Module 3: Attention Mechanism and Key Feature Recognition	Logic of key feature extraction and screening	Data analysis ability
Module 4: Job Demand Forecasting and Talent Matching Logic	Demand forecasting, matching rules, scheme design	Project analysis ability
Module 5: System Optimization and Feedback Evaluation	Result feedback, optimization, iterative improvement	Problem-solving ability
Module 6: Project Reporting and Result Presentation	Project summary, result presentation, reflective improvement	Expression ability; collaboration ability

4.2 Constructing the Project Task Chain

To ensure the effective implementation of project-based and task-driven learning, this study simultaneously promoted the construction of a school-enterprise collaborative practice platform.

The platform connected enterprise needs, project development processes, and teaching implementation, providing students with learning scenarios closer to workplace reality. Supported by authentic task contexts from the enterprise, institutional and resource support from the university, and the construction of a training base, the course extended from classroom explanation to project practice. In educational terms, the platform played at least three roles. It provided authentic situations in which students could understand the applied value of course knowledge; it offered practical conditions for continuous training, scheme testing, and outcome display; and it created a collaborative environment in which university teachers and enterprise mentors could jointly guide students. Such a platform is particularly important for applied undergraduate education because competence development often depends on repeated exposure to realistic tasks and iterative feedback rather than one-time classroom performance.

Table 2 Project Task Arrangement and Competency Development Plan

Task No.	Project Task	Main Teaching Content	Week(s)	Main Competence Focus
Task 1	Analyze enterprise job demand and talent pain points	Enterprise background, job demand sorting, talent turnover and matching problem analysis	Week 1	Job awareness; problem analysis ability
	Extract key entities from job descriptions and résumés	Job text parsing, résumé information identification, key element extraction	Week 2	Information extraction ability; data processing ability
Task 3	Construct the	Relationship sorting and	Weeks 3–	Knowledge integration

Task No.	Project Task	Main Teaching Content	Week(s)	Main Competence Focus
Task 4	initial job-skill	structured representation	4	ability; structured
	relationship	of job, skill, and talent		thinking ability
	graph	information		
	Design			
	matching logic	Job demand forecasting		
	and	ideas, matching rule	Weeks 5–	Project analysis ability;
Task 5	recommendation	design, recommendation	6	scheme design ability
	rules	logic construction		
	Complete a			
Task 6	system	System prototype design,		Practical application
	prototype or	function explanation,	Week 7	ability; result
	solution	project result formation		transformation ability
	presentation			
Task 6	Conduct project			Expression and
	reporting,	Project reporting,		communication ability;
	defense, and	defense, feedback	Week 8	teamwork ability;
	reflective	summary, and		reflective improvement
	improvement	optimization		ability

4.3 Building a School-Enterprise Collaborative Practice Platform

To improve the practical and interactive nature of the course, this study adopted a teaching organization model that combined classroom instruction with project discussion, collaborative guidance from university teachers and enterprise mentors, group-based project development with

staged reporting, and online learning with offline practical training. Necessary theoretical instruction was still retained, but it no longer functioned as the sole center of the teaching process. Instead, teachers used theory to frame project understanding, introduce methods, and support students' task completion. Real project scenarios and concrete tasks were then introduced to organize discussion, group collaboration, and scheme development. This organizational reform reflected a shift from teacher-centered one-way transmission to learner engagement in meaningful tasks. The combination of online and offline settings further expanded the learning space: students could access materials, receive tasks, and communicate online, while conducting operation, verification, and presentation in offline practice settings. Through this arrangement, students were encouraged to learn through participation, discussion, experimentation, and reflection.

4.4 Reforming the Teaching Organization

To more comprehensively reflect students' learning performance and competence development in real project contexts, this study established a multiple evaluation mechanism that integrated process evaluation, project evaluation, multi-subject evaluation, and achievement-oriented evaluation. Process evaluation focused on classroom participation, task completion, staged reports, and learning engagement; project evaluation examined scheme design, model logic, and practical effects; multi-subject evaluation combined teacher evaluation, enterprise mentor evaluation, peer assessment, and self-reflection; and achievement-oriented evaluation assessed project reports, system demonstrations, and course summaries. This mechanism was designed to overcome the limitations of a single final assessment model. In project-driven teaching, competence is often manifested through continuous participation, collaborative contribution, iterative adjustment, and quality of practical outputs. Therefore, evaluation should not only judge

whether students have obtained a final answer, but also examine how they analyze problems, allocate tasks, respond to feedback, and refine their schemes. The multiple evaluation mechanism used in this reform thus supported both fairer judgment and stronger learning guidance.

5 Implementation of the Teaching Reform

5.1 Participants and Duration

The reform was implemented among 56 junior students majoring in management-related disciplines in a related course over an 8-week period. Junior students were selected because they had already acquired a basic foundation in management, job analysis, and course project participation, enabling them to engage in job demand analysis, task decomposition, scheme design, and outcome presentation under the guidance of teachers and a real enterprise project. The choice of management-related students was also appropriate because the project centered on job demand identification, talent matching, and organizational management, which aligned well with the curriculum characteristics of such majors. In addition, this student group was at a stage where career cognition was becoming more concrete, making it meaningful to introduce job-oriented project tasks. The combination of participant background, course content, and project requirements therefore provided a relatively suitable implementation context for the reform.

Table3 Evaluation Framework for Project-Based Teaching

Evaluation Dimension	Evaluation Content	Evaluators	Purpose
Process evaluation	Class participation, task	Teachers; student	Focus on learning process
	completion, stage reports	groups	and task implementation
Project evaluation	Scheme design, model logic,	Teachers; enterprise	Assess project analysis and

Evaluation Dimension	Evaluation Content	Evaluators	Purpose
	application effects	mentors	practical application ability
Evaluator diversity	Teacher evaluation, enterprise	Teachers; enterprise	Improve comprehensiveness
	mentor evaluation, peer	mentors; students	and objectivity of evaluation
	assessment, self-reflection		
Outcome evaluation	Project reports, system	Teachers; enterprise	Examine result quality and
	demonstrations, course	mentors	comprehensive expression
	summaries		ability

5.2 Implementation Procedure

The reform was carried out in three stages: preparation, implementation, and summary. In the preparation stage, enterprise investigation, job demand sorting, and project content screening were conducted to clarify the authentic task scenarios on which the reform would rely. Based on this work, a course task bank connected to teaching objectives was formed. In the implementation stage, project tasks were embedded into classroom teaching and practical training in accordance with the teaching schedule. Students carried out project practice around such tasks as job demand analysis, information extraction, matching logic design, and staged reporting. Teachers provided theoretical explanation, process guidance, and feedback, while enterprise mentors helped connect the tasks with workplace expectations. In the summary stage, students completed outcome display, project defense, and comprehensive evaluation. Feedback from different evaluation sources was then used to form a closed loop for teaching improvement and student development. This staged procedure ensured that reform implementation was not reduced to a single project presentation, but became a sustained teaching process with preparation, action, feedback, and reflection.

5.3 Support Conditions

To ensure smooth implementation, a relatively complete support mechanism was established. The enterprise provided authentic data sources, job demand information, and task scenarios, which gave the course practical grounding. The university offered institutional, organizational, and financial support through its mechanisms for curriculum reform, school-enterprise collaboration, and industry-education integration. The practice base and related platforms provided technical and contextual support for project training, task implementation, and outcome presentation. Meanwhile, the teaching team played a dual role in course instruction and project guidance, coordinating theoretical explanation, task design, process supervision, and achievement review. Together, these forms of support reduced the common implementation risks of project-driven reform, such as insufficient practical resources, disconnected enterprise participation, or lack of teaching coordination. They also made it possible for the reform to operate in a more stable and sustainable way.

6 Outcomes of the Teaching Reform

6.1 Improvement in Students' Learning Engagement

Under the real project-driven model, students' learning status gradually shifted from passive listening to active participation. Compared with traditional knowledge-receiving learning, the introduction of project tasks increased students' interest in job demand analysis, talent matching, and scheme design, and improved their willingness to take part in classroom discussion, staged reporting, and outcome presentation. During implementation, students showed stronger engagement in task discussion, group cooperation, and classroom interaction, and most groups maintained steady progress in completing assigned tasks. This change is educationally important

because learning engagement in applied undergraduate education is not simply a matter of attention in class; it is closely related to students' willingness to invest effort in complex tasks, communicate with peers, and repeatedly revise their work. The project-driven design created a sense of relevance and responsibility, making the learning process more purposeful. Students were no longer only receivers of explanations, but participants in an ongoing project process. Such changes indicate that real project contexts can effectively activate learning motivation and improve classroom participation.

6.2 Improvement in Practical and Comprehensive Application Abilities

By embedding real enterprise projects into curriculum teaching, students gradually improved their abilities in data processing, demand analysis, scheme design, and collaborative communication during task implementation. In such tasks as sorting job information, decomposing project tasks, designing matching logic, and presenting project outcomes, students were able to apply course knowledge to actual problem solving rather than merely reproducing isolated concepts. Most student groups completed the assigned project tasks, and a majority were able to present relatively complete project schemes and outcome reports. This suggests that the reform supported not only practical competence, but also the integration of multiple abilities. In applied undergraduate education, comprehensive application ability is reflected in whether students can connect methods with context, transform information into workable solutions, and communicate these solutions clearly in a team setting. The present reform helped create such opportunities. Through repeated engagement in authentic tasks, students improved their ability to

connect abstract knowledge with operational demands, which is a core indicator of applied talent cultivation.

6.3 Stronger Alignment Between Curriculum Teaching and Job Requirements

After real enterprise projects entered the classroom, the connection between course content and job requirements became closer. Previously, students' understanding of relevant knowledge often remained at a conceptual level, and they might not have recognized how such content as job demand identification, talent matching, data organization, and recommendation logic could be used in real professional settings. Under the project-driven model, however, students learned these topics while working on tasks derived from enterprise needs, which made the applied value of course knowledge more visible. As a result, the course gained stronger practical orientation and clearer relevance to workplace competence. This alignment is especially important for management-related majors, whose curriculum quality is often judged by whether students can understand organizational problems and respond to them with feasible solutions. By embedding enterprise tasks into teaching, the reform helped narrow the gap between curriculum knowledge and job practice, thus strengthening the applied character of the course.

6.4 Enhanced Effects of School-Enterprise Collaborative Education

The reform based on real enterprise projects not only improved the practical nature of the course, but also strengthened the actual effect of school-enterprise collaborative education. During implementation, enterprise mentors participated in course guidance and achievement review, while authentic enterprise cases and task scenarios were effectively introduced into classroom teaching. Students therefore had more opportunities to encounter real work situations, understand practical expectations, and experience how theoretical learning could support project

development. At the same time, the practice base and related platforms supported task implementation, project training, and outcome presentation, extending learning from the classroom to a more practice-oriented educational space. This indicates that school-enterprise collaboration in the reform was not limited to symbolic cooperation or resource provision. Rather, it functioned as a substantive educational mechanism that linked project sources, teaching processes, practice conditions, and evaluation participation. Such collaboration is valuable for applied undergraduate education because it makes talent cultivation more open, contextualized, and responsive to industry needs.

7 Discussion

The outcomes of this reform can be understood from the perspective of competence-oriented curriculum design. In traditional classroom teaching, students often learn concepts, methods, and procedures separately, and their performance is mainly judged through written tests or isolated assignments. Such an arrangement may help students remember knowledge, but it does not necessarily help them develop the capacity to use knowledge in complex situations. The present reform addressed this limitation by organizing learning around a real enterprise project. This arrangement increased task authenticity, made the purpose of learning clearer, and required students to coordinate multiple forms of knowledge and skill in order to complete project tasks. This is consistent with the idea of constructive alignment: when learning outcomes, teaching activities, and assessment are aligned around meaningful tasks, students are more likely to develop usable competence rather than fragmented knowledge (Biggs, 1996; Biggs & Tang, 2011).

The reform also reflects the logic of experiential and project-based learning. Students did not encounter knowledge graph concepts, matching logic, or job demand analysis as isolated theoretical units. Instead, they learned these through engagement with practical problems, team discussion, task implementation, outcome display, and reflective improvement. In this sense, the course created a learning cycle in which experience, reflection, conceptual understanding, and action were closely connected (Kolb, 1984). The project task chain supported progressive learning by reducing the complexity of the full enterprise project into achievable stages, while still preserving the authenticity of the overall problem. This design helped students gradually build confidence and competence. Prior studies on project-based and problem-based learning have similarly shown that meaningful tasks can enhance higher-order thinking, collaboration, and transfer of learning (Thomas, 2000; Barron et al., 1998; Hmelo-Silver, 2004). The present reform provides a practical example of how such principles can be implemented in management-related applied undergraduate courses.

Another important implication of the findings lies in the relationship between curriculum teaching and job requirements. Applied undergraduate education is often expected to cultivate talents who can adapt to practical work contexts, yet many courses still operate under a content-dominant logic. In such courses, the teacher's primary responsibility is to finish a syllabus, while students' responsibility is to master examinable points. The school-enterprise collaboration project shifted this logic by making enterprise needs a visible part of teaching design. Students had to understand not only "what" they were learning, but also "why" the knowledge mattered and "how" it could be transformed into solutions. This strengthened their awareness of job fit and made curriculum learning more professionally meaningful. The reform therefore suggests

that the value of school-enterprise collaboration does not lie only in inviting external partners to the classroom, but in using enterprise tasks to redesign the structure of learning itself.

The multiple evaluation mechanism further strengthened the educational value of the reform. In many conventional courses, evaluation is dominated by final scores, which can neither fully represent students' practical contribution nor effectively guide improvement during learning. In the present reform, process performance, project quality, achievement presentation, peer input, self-reflection, and mentor feedback were all incorporated into evaluation. This made assessment both more developmental and more authentic. Students were encouraged to view evaluation not simply as a judgment at the end of the course, but as an ongoing source of feedback that could improve their performance. From a teaching perspective, this mechanism also gave instructors richer information about students' participation, difficulties, and growth. It therefore supported more targeted intervention and more meaningful assessment of competence.

From the perspective of curriculum governance, the reform also provides a practical route for balancing academic content and industry relevance. A common concern in applied undergraduate education is that close cooperation with enterprises may narrow the curriculum to immediate technical needs and weaken broader educational value. The present reform suggests a different possibility. Real enterprise projects need not replace academic learning; instead, they can reorganize and deepen it. In this study, students still learned conceptual content, but concepts were taught in relation to project tasks and reflective use. This made learning both more concrete and more intellectually demanding because students had to interpret, apply, discuss, and revise their understanding in action. Therefore, project-driven reform should not be understood merely as adding practice to teaching; it is better understood as redesigning the relationship between theory and practice in the curriculum.

The reform further highlights the importance of teacher roles in project-driven teaching. When real enterprise tasks are introduced into the classroom, teachers are no longer only lecturers or assessors. They also become task designers, process coordinators, feedback providers, and mediators between academic requirements and enterprise expectations. This expanded role requires teachers to possess not only disciplinary knowledge, but also curriculum integration ability and practical coordination skills. At the same time, enterprise mentors are not expected to replace teachers. Their main value lies in providing contextualized guidance, workplace perspectives, and criteria related to task authenticity. In this sense, successful school-enterprise collaborative education depends on clear role allocation and sustained communication. The present study indicates that when teachers and enterprise mentors work in complementary ways, students benefit from both pedagogical support and practical relevance.

A further implication concerns the design of interdisciplinary learning in management-related education. The enterprise project used in this study involved not only organizational and human resource issues, but also data thinking, information structuring, recommendation logic, and platform-based implementation. In many university curricula, such dimensions are separated into different courses or even different majors, which can make it difficult for students to understand how knowledge from different domains works together in practice. By contrast, the project-driven reform provided an interdisciplinary task environment in which management knowledge was learned together with technological awareness and practical reasoning. Students did not need to become software engineers, but they did need to understand how data, logic, and organizational needs interact in a practical system. This kind of learning is highly relevant to the development of contemporary applied talents, especially in fields where management work increasingly relies on digital tools and data-supported judgment. The reform therefore

demonstrates that a real enterprise project can become a bridge between disciplinary learning and interdisciplinary application. It also suggests that applied undergraduate curricula should not isolate technical literacy from professional competence, but should build opportunities for students to understand how different knowledge domains jointly contribute to workplace problem solving.

The present study also has implications for the sustainability of teaching reform. Many curriculum reforms achieve short-term innovation through one-off activities, special competitions, or temporary case teaching, but they often fail to become stable parts of regular teaching. The model developed in this study has a stronger possibility of sustainability because it is built on a replicable logic rather than on a single classroom event. Course content was reconstructed around project modules, implementation was organized through a visible task chain, platform support was linked to practice conditions, and evaluation was redesigned to match the logic of project participation. These features mean that the reform can be repeated, adjusted, and transferred to later cohorts with relatively clear procedures. At the same time, the reform highlights that sustainability depends on continued cooperation between the university and the enterprise. If enterprise participation weakens or project resources are not updated, the authenticity and value of project-driven teaching may decline. Therefore, long-term curriculum reform should institutionalize school-enterprise collaboration, regularly update project resources, and support teachers in developing the competencies needed for project design and guidance. Only under such conditions can project-driven reform move from experimental practice to normalized curriculum construction.

In addition, the findings have practical significance for assessment reform in applied undergraduate education. Traditional assessment often privileges efficiency and standardization,

which makes it easier to manage large classes but less effective in identifying real competence differences among students. Project-driven teaching creates a need for richer assessment because students contribute in different ways across the learning process. Some perform strongly in information collection and task analysis, some in organizing collaboration, and some in presenting and refining final schemes. The multiple evaluation mechanism adopted in this study provided a more balanced way of recognizing such differentiated performance. It also encouraged students to treat feedback as a resource for revision rather than as a final judgment. For institutions seeking to improve the quality of applied talent cultivation, this approach is valuable because it aligns assessment with the diversity and complexity of real professional tasks. In this sense, the reform does not only improve one course; it also offers a concrete model for rethinking how curriculum quality can be assessed in competence-oriented higher education.

8 Limitations and Future Improvement

Despite its positive outcomes, this study has several limitations. First, the reform was implemented among 56 junior students from management-related disciplines within a relatively short period of eight weeks. Although this scope was suitable for an initial teaching reform practice, the sample size and implementation duration limit the generalizability of the findings. Future studies may include students from other majors, grade levels, or institutions in order to test whether the model can be effectively transferred to broader contexts. Second, the present study mainly evaluated reform outcomes through teaching observation, project completion, classroom performance, and overall student feedback. While such evidence is meaningful for a teaching reform study, the use of more systematic quantitative tools, such as structured questionnaires, rubric-based comparative scores, or longitudinal follow-up data, would further strengthen the persuasiveness of the conclusions.

Third, the current reform was based on one specific enterprise project related to talent matching and job demand forecasting. Although this project was highly suitable for management-related and interdisciplinary teaching, future reforms could explore whether other enterprise projects with different professional logics produce similar educational effects. Fourth, the participation of enterprise mentors and practice platforms, though effective in the present case, may vary across institutions because of differences in resource availability, collaboration mechanisms, and curriculum scheduling. Therefore, future work should pay greater attention to the sustainability of school-enterprise collaboration, the standardization of project resources, and the institutional mechanisms needed to support long-term reform. Even with these limitations, the present study provides a meaningful and transferable path for integrating real enterprise projects into applied undergraduate teaching.

9 Conclusion

Relying on a real enterprise project and oriented toward the cultivation of application-oriented undergraduate talents, this study explored a project-driven teaching reform path in the context of school-enterprise collaboration and constructed an integrated “course-project-training-evaluation” model. By embedding authentic enterprise tasks into teaching, the reform promoted coordinated improvement in course content reconstruction, project task implementation, practice platform support, and multiple evaluation feedback. The findings indicate that this model contributed to students’ learning engagement, practical competence, comprehensive application ability, and awareness of job fit. More broadly, the reform demonstrated how real enterprise projects can serve as effective teaching carriers in applied undergraduate education. They can help transform teaching from knowledge transmission to task-driven and practice-oriented learning, strengthen the connection between curriculum teaching and industry needs, and

improve the quality of school-enterprise collaborative education. Although the present study was conducted within a limited implementation scope, it provides a useful practical reference for universities seeking to advance curriculum reform under the background of industry-education integration.

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Two Paths to Equality: Differences Between Rawls and Cohen on Equality

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Abstract

In contemporary egalitarian theory, the debate between John Rawls and G. A. Cohen over justice and equality is especially representative. Rawls, beginning with a critique of utilitarianism, constructs the two principles of justice through the device of the veil of ignorance and establishes a liberal egalitarian path grounded in the basic structure of society. Cohen, from the standpoint of analytical Marxism, develops an internal critique of Rawls by challenging the scope of justice and the incentive argument. On that basis, Cohen, as a radical luck egalitarian, advances a theory centered on equal access to advantage, socialist equality of opportunity, and the community principle. He insists that justice must extend to personal choice and egalitarian ethos, and that theory should not compromise with self-interested motivation. Their divergence ultimately stems from different assumptions about human motivation and different theoretical commitments. They therefore represent two distinct paths to equality—one based on institutional accommodation and the other on moral purity. The comparison not only reveals the internal tension of contemporary theories of justice, but also offers important insights into the coordinated role of institutions and social ethos in the pursuit of equality.

Keywords: difference principle; interpersonal test; radical luck egalitarianism; justificatory community

Equality is a central issue in modern political philosophy and an enduring concern of Marxist theories of justice. How equality should be understood, and how freedom and equality should be balanced, has long been a focus of philosophical controversy. In contemporary discussions, Rawls and Cohen represent two highly influential theoretical paths. With justice as fairness at the core of his project, Rawls uses the difference principle to place limits on social inequality and seeks institutional arrangements that benefit the least advantaged while

recognizing factual differences in society. Cohen, by contrast, criticizes Rawls from the standpoint of analytical Marxism and argues for a more demanding conception of equality.

Existing scholarship has mainly concentrated either on explicating Rawls's theory of justice, on clarifying Cohen's egalitarian thought, or on Cohen's criticisms of particular Rawlsian claims such as the difference principle. Although these studies have yielded valuable results, the divergence between the two paths to equality and their deeper internal connection still require more systematic treatment. This article therefore analyzes Rawls's and Cohen's approaches separately, identifies the theoretical characteristics and limits of each, and aims to deepen our understanding of the internal tension within contemporary egalitarian thought.

Rawls's Path to Equality: Institutional Justice and the Difference Principle

In contemporary political philosophy, the institutional path of justice developed by Rawls is one of the major branches of egalitarian theory. Classical utilitarianism, represented by Bentham and Mill, takes "the greatest happiness of the greatest number" as the standard of justice and treats individual rights as instruments for maximizing aggregate welfare. For that very reason, however, it has been criticized for neglecting individual distinctiveness and for making it possible to sacrifice minorities for the sake of overall benefit. Some scholars have noted that, in Mill's utilitarianism, the motivational logic of pursuing pleasure and avoiding pain, together with the priority of aggregate happiness, effectively dissolves the independent moral standing of the individual (Yi & Zhang, 2016), while distributive equality is never treated as a fundamental value in classical utilitarianism (Duan, 2024). Rawls's intervention begins precisely here. As he argues, any theory, no matter how elegant, must be rejected if it is untrue, and institutions, no matter how efficient, must be reformed or abolished if they are unjust; every person possesses an inviolability founded on justice that cannot be overridden even in the name

of overall social welfare (Rawls, 2009, p. 3). For Rawls, the deepest problem with utilitarianism is that it does not take seriously the distinction between persons and may gravely violate the basic rights of innocent minorities for the benefit of the majority.

In *A Theory of Justice*, Rawls makes clear that he seeks to formulate a conception of justice that can replace both general utilitarianism and its many variants (Rawls, 2009, p. 21). A key point is that he restricts the scope of justice to the domain of social institutions. The primary subject of justice is the basic structure of society: the distribution of basic rights and duties and the regulation of social and economic inequalities and the legitimate expectations attached to them. Since people's starting positions are deeply shaped by morally arbitrary factors, and those factors are themselves major sources of deep social inequality, Rawls argues that a just basic structure must be built to constrain inequalities generated by contingency. On the premise of fair opportunity, only those inequalities that work to the advantage of the least advantaged are permissible (Rawls, 2009, p. 85).

To derive legitimate principles of justice, Rawls introduces the original position and the veil of ignorance. The original position is a hypothetical fair choice situation, and the veil of ignorance is the information-blocking device that secures its fairness. Behind the veil, the parties possess only general social knowledge and know nothing about their own personal traits or social positions (Rawls, 2009, p. 6). Under such conditions, Rawls believes that rational parties would choose principles by means of a maximin strategy—that is, they would select the option whose worst possible outcome is more acceptable than the worst outcomes of the alternatives (Li, 2025). This arrangement ensures that no one can tailor principles to their own natural or social advantages, and it makes the principles of justice the result of a fair agreement among equals (Rawls, 2009, p. 12).

Rawls holds that the parties would ultimately agree on two principles of justice. The first principle states that each person has an equal right to a fully adequate scheme of equal basic liberties compatible with the same scheme for all. The second principle states that social and economic inequalities are to be arranged so that they are both to the greatest benefit of the least advantaged, consistent with the just savings principle, and attached to offices and positions open to all under conditions of fair equality of opportunity (Rawls, 2009, p. 302).

The first principle is the principle of equal basic liberty. It emphasizes that liberty is universal rather than a privilege for a few, and that liberty may be limited only for the sake of liberty itself, not traded away for economic gain. On questions of distribution, Rawls does not defend absolute equality, because he believes strict equalization would undermine incentives for the talented and reduce the total social product, thereby harming those at the bottom. He therefore acknowledges the factual possibility of social and economic inequality, but insists that any such inequality must be strictly constrained by justice. This is the role of the second principle. Its first layer is the difference principle, which Cohen glosses as the claim that inequalities are just if, and only if, they are necessary to improve the condition of the worst off (Cohen, 2014, p. 68). On this view, reasonable income differences may be allowed if they motivate the talented to produce more and thereby improve the lives of the least advantaged through redistribution. Such inequality is not justified as privilege, but as a means of lifting the position of those who are worst off. The difference principle incorporates the interests of the least advantaged into the core of institutional design and expresses respect for the equal moral standing of all persons. At the same time, it has been criticized for granting the least advantaged what amounts to a veto over inequality without adequately explaining why they are

disadvantaged in the first place, whether because of choice, luck, or other causes (Machin, 2013). This weakness later becomes an important point of entry for Cohen's internal critique of Rawls.

The second layer of Rawls's second principle is fair equality of opportunity. Rawls carefully distinguishes it from merely formal equality of opportunity. Formal equality means only that everyone has the same legal right to compete for advantageous social positions, while leaving the initial distribution of resources strongly affected by natural and social contingencies (Rawls, 2009, p. 72). Because this merely juridical equality does not remove the substantive disadvantages produced by family background, education, and other arbitrary circumstances, Rawls regards it as insufficiently just. Other scholars have made a similar point, arguing that a system of natural liberty fails to restrict the effects of natural chance and social arbitrariness on initial distribution and therefore contains obvious injustice (Wang, 2021). By contrast, fair equality of opportunity requires that individuals with similar talents and similar willingness to use them should enjoy roughly equal prospects of success; achievement should track talent and effort rather than class position (Tang, 2024). Compared with formal opportunity, fair equality of opportunity seeks a fairer starting point. It secures legal equality while also trying to neutralize factors unrelated to personal ability, such as family background and educational resources, so that individuals can gain comparable opportunities through their own efforts. In this sense, it surpasses merely formal equality and responds more directly to real patterns of inequality. Yet even this principle has limits, because it still cannot guarantee genuinely fair competition for people disadvantaged by natural talent or bodily condition.

Rawls explicitly gives lexical priority to the first principle over the second: the institutional system of equal liberty cannot be violated even for the sake of larger social or economic gains (Rawls, 2009, p. 62). Liberty is the basis of personhood and, in the author's view,

also a cornerstone of socialism. This prioritization reflects Rawls's resolute defense of basic rights and dignity. It also shows that, when freedom and equality come into tension, Rawls gives priority to satisfying the demands of freedom. Once liberty is secured, inequality is tolerated only within limits that improve the condition of the least advantaged. This view of equality simultaneously protects liberty and takes equality seriously, but its tolerance of incentive-based inequality and its restriction of justice to institutions leave room for later radical egalitarian criticism.

Cohen's Internal Critique of Rawls and His Theory of Equality

As a representative figure of analytical Marxism, G. A. Cohen was deeply shaped by communist ideals from an early age and maintained a strong commitment to socialist equality. He broadly accepts Rawls's first principle, the principle of equal liberty, but clearly opposes the second principle. In Cohen's view, the incentive-based interpretation of the difference principle cannot be reconciled with the inner demands of justice, and the Rawlsian principle of fair equality of opportunity still remains vulnerable to social and natural contingencies. Cohen also questions Rawls's restriction of justice to the basic structure alone. On this basis, he develops a more demanding luck-egalitarian alternative that attempts to rescue justice from Rawls's insufficiently egalitarian theory.

Reconstructing the Scope of Justice

Rawls argues, on the one hand, that principles of justice apply to the basic structure and that social institutions should be designed so that, whatever happens, the resulting distribution is just (Rawls, 1999, pp. 242–243). Because the basic structure profoundly shapes people's social starting points and life prospects, Rawls believes that the first task of justice is to correct institutional injustice. He also assumes that, in a well-ordered society, people hold different life

plans and conceptions of the good. If justice were used to assess people's character or personal choices, the state would effectively impose a unified moral standard and thereby violate freedom. For that reason, he confines justice to the basic structure and does not direct it at personal virtue. Yet Rawls remains notably ambiguous on one crucial question: whether the family belongs to the coercive basic structure. He acknowledges that the family deeply affects social justice, but he hesitates to incorporate internal family relations fully into a coercive framework of justice.

Feminist theorists were among the first to notice that this ambiguity leaves unjust divisions of labor within the family and the disadvantaged position of women outside the corrective reach of principles of justice. Susan Okin argues that Rawls's wavering on this issue is not a minor indecision, because the problem could be more readily addressed if the family were consistently recognized as part of the basic structure (Abbey, 2016). Cohen extracts from this difficulty a broader point: choices not directly regulated by law still fall within the basic concern of justice (Cohen, 2009, pp. 157–159). In other words, justice does not reside only in legal rules; it also concerns the domain of free choice. At the same time, Cohen rejects the simple solution of merely redefining the family as part of the basic structure if Rawls continues to insist that distributive justice applies only there. If Rawls does not abandon that restriction, Cohen argues, the family cannot be coherently absorbed into the basic structure (Cohen, 2009, p. 159).

According to Cohen, if the Rawlsian basic structure includes only coercive institutions, then many noncoercive factors that powerfully shape distribution—such as inequality inside families and the influence of social ethos on personal choice—are excluded from assessment by justice, even though their effects are no weaker than those of coercive institutions. If Rawls retreats to a purely coercive structure, he contradicts the scale of justice implicit in his own judgments and saddles himself with an arbitrary and unduly narrow account of the subject of

justice (Duan, 2010). If, by contrast, he admits noncoercive factors into the basic structure, then the personal choices in which those factors ultimately terminate will themselves become objects of justice, and Rawls's long-standing claim that justice constrains institutions but not personal choices or motives can no longer stand. Cohen therefore concludes that the scope of justice must move beyond the boundaries of the coercive basic structure and include everyday individual choice and egalitarian social ethos. Without such constraints, even just institutions will be steadily eroded by noninstitutional factors, undermining the realization of equality and justice.

The Injustice of the Incentive Argument

The theoretical support for Rawls's difference principle is the incentive argument. On this view, talented people require higher incomes as incentives to work hard; without those extra rewards they will reduce their productive effort, thereby lowering total output and ultimately harming the least advantaged. Providing high salaries to the talented thus appears justified. Cohen argues, however, that the moral structure of this argument is isomorphic with the logic of ransom. In *Rescuing Justice and Equality*, he illustrates the point through the example of a kidnapper: the kidnapper first creates the threat that the child will not be returned unless ransom is paid, and then invokes the desirable end of reuniting child and parents to justify the payment (Cohen, 2014, p. 34).

Cohen argues that the incentive logic of the talented works in exactly the same way. The talented first choose a self-interested strategy—namely, not to work as hard unless they are paid more—and then transform that private choice into a social fact that everyone else must accommodate. They finally appeal to the good of the least advantaged to cloak their salary demands in moral language. Cohen therefore insists that this is not a genuine defense of justice but a form of moral blackmail by which the talented use their productive advantage as bargaining

power. To reinforce the critique, he proposes the interpersonal test: when a policy argument is advanced, its force should be tested by asking whether it can serve as a justification when addressed by any member of society to any other affected member face to face (Cohen, 2014, p. 37). If the talented were to tell the least advantaged, “I must receive a high salary or I will not work hard, and then your condition will be worse; therefore I ought to be paid more for your sake,” the least advantaged would have every reason to reject the claim. If the talented truly accept the difference principle, why can they not still work conscientiously within a more equal framework? Because the incentive argument depends on a power asymmetry rather than a publicly acceptable reason, it fails the interpersonal test.

Moreover, the incentive argument also lacks legitimacy from the standpoint of the original position. Rawls introduces the veil of ignorance precisely to block the influence of morally arbitrary factors such as natural talent and social origin on distribution, treating the distribution of natural talent as a common social asset rather than as private desert. Yet the incentive argument allows the talented to demand extra rewards on the basis of their giftedness and thereby convert morally arbitrary natural advantages into private gain. For Cohen, this runs directly against the original aspiration of fair distribution.

Cohen’s Core Claim: Radical Luck Egalitarianism

Building on his critique of Rawls’s account of the scope of justice and of the incentive argument, Cohen constructs a more thoroughgoing egalitarian theory. Luck egalitarianism in a broad sense aims to ensure that people bear reasonable responsibility for their own situations only once morally arbitrary contingencies no longer dominate their lives. Cohen radicalizes this view by refusing to treat individual choice and responsibility too quickly as sufficient justification for inequality.

In “On the Currency of Egalitarian Justice,” Cohen advances the idea of equality of access to advantage. Engaging left-liberal egalitarians such as Ronald Dworkin, Rawls, and Richard Arneson, he argues that neither the Rawlsian and Dworkinian focus on resources nor the Arnesonian focus on opportunity for welfare is adequate. Resource-based views overlook individuals’ unequal capacities to convert resources into actual well-being, while welfare-based views risk requiring compensation for expensive tastes that people voluntarily cultivate. As some commentators summarize, earlier liberal egalitarianism concentrated on compensating inequalities caused by deficits of welfare or resources, but often neglected the responsibility individuals bear when inequality results from their own choices (Yi, 2021). Cohen’s notion of “advantage” is intended to move beyond this opposition. It is a heterogeneous cluster that includes objective resources, subjective welfare, and the conditions under which capacities can be transformed into actual benefit (Cohen, 2011). Because of this broader structure, it can better capture the real circumstances of people’s lives and offer a more inclusive metric of equality.

At the level of implementation, Cohen emphasizes equality in access rather than identity of outcomes. The point is to ensure that everyone has an equal chance to secure advantage, not to force everyone into identical lives. On this basis, only involuntary disadvantages—disadvantages for which agents cannot reasonably be held responsible—should trigger compensation. Once all such disadvantages are corrected, resulting inequalities can in principle be justified (Duan, 2021). Cohen’s proposal thus seeks to strengthen the moral coherence of egalitarian compensation by targeting the elimination of nonvoluntary disadvantage.

Compared with liberal equality, Cohen’s principle of socialist equality of opportunity is still more demanding. It requires not only the elimination of socially produced inequalities, but also the neutralization of advantages generated by differences in upbringing and natural

endowment. On this view, inequalities in distribution should track only individuals' choices and preferences. Yet socialist equality of opportunity does not remove every inequality generated by personal conduct. Three kinds of inequality may still arise: those stemming from preference, from choice, and from sheer luck. If left unchecked, however, these differences may expand without limit, producing severe wealth polarization, destroying egalitarian and fraternal social relations, and violating socialist principles. As some scholars in the analytical Marxist tradition argue, class differentiation and the wealth inequalities that follow from it are unacceptable, because once such inequalities are accepted and dignified as justice, one effectively walks alongside evil (Guan & Jiao, 2025).

For this reason, Cohen introduces the community principle. Its function is to prevent inequality from expanding excessively, so that society can preserve room for individual choice while also maintaining equality and solidarity. Under the community principle, those with greater talents would still be willing, even in the absence of coercive rules, to work for the common good and to share their additional gains with others. People would no longer use their skills to bid one another up and extract larger benefits from one another. As one scholar succinctly puts it, a truly just society cannot rely on structural mechanisms alone; it also requires a just ethos capable of shaping the choices of social agents (Chen, 2024). Critics have asked whether Cohen's proposal places too much weight on individuals' moral self-consciousness and ignores the ubiquity of self-interest in real societies. Cohen responds that the normative reasonableness of an egalitarian ideal is not refuted by the fact that it is difficult to realize in practice. He readily admits that modern societies know how to mobilize self-interest to raise efficiency, but they do not know how to design institutions that can activate the generosity people also possess and make an economy run on that basis (Cohen, 2011a, p. 58).

The Core Differences Between Rawls and Cohen and an Assessment

Different Attitudes Toward Human Nature and Personal Motivation

The contrast between Rawls and Cohen becomes especially vivid when one considers their different attitudes toward human nature and personal motivation. Cohen dramatizes the issue by imagining a doctor who knows that an annual salary of £100,000 is available for a hospital post, but also believes that any gap between her pay and the pay of others is justified only if it compensates for the actual burdens and costs of doing the job. She then wonders how she can sincerely affirm that justice forbids inequalities harmful to the poor while at the same time demanding the full salary rather than only what is strictly needed to do the work (Cohen, 2014, pp. 63–64). The example captures the doctor’s perplexity: she wants a high income, yet she also recognizes the demands of fairness. If she accepts only the compensation necessary for the burdens of the job, it appears as though she is making a personal sacrifice. How, then, should one act when private interest and social justice pull in different directions?

Rawls’s answer is that incentives are necessary and that some inequality is acceptable. This follows from his less stringent reading of the difference principle, which allows the necessity of inequality to depend on the subjective choices of the talented (Duan, 2022). From a Rawlsian perspective, the doctor’s salary demand is indeed self-interested, but it is intelligible within real social conditions and is not excluded by the theory so long as the resulting inequality improves the position of the least advantaged. Natural talents belong in a sense to the common pool of social assets, yet material incentives may still be needed to ensure that those talents are fully exercised. Cohen, by contrast, maintains that if the doctor effectively says, “Pay me more or I will not do the work,” then her behavior amounts to a kind of extortion. He insists on a stricter reading of the difference principle according to which only inequalities grounded in

objective necessity, not in strategically chosen motives, can be justified. To use natural advantage as bargaining leverage is not a morally innocent exercise of personal choice; it is a threat directed at the collective good. In a truly just society, Cohen argues, the doctor should be motivated by the vocation to heal and by responsibility to the community. In this respect, Cohen's judgment also resonates with the Kantian test of universalizability: if the maxim "I will perform my duties only when paid a premium" were universalized, social cooperation would collapse under the weight of mutual self-interested bargaining.

The deeper disagreement concerns their different understandings of a just society. Rawls focuses on regulating conflicts of interest through institutions rather than transforming human nature itself. His project is to design rules under which even self-interested people will behave in socially beneficial ways. Cohen asks a more demanding question: if citizens do not possess a genuine sense of justice in their hearts, can a society secured only by institutions really count as just? For him, true egalitarians should work from concern, solidarity, and a willingness to share, not from a constant calculation of compensation. Society reaches justice only when the doctor no longer desires that additional income from the inside out.

The Necessity of Their Divergence: The Essential Incompatibility Between Luck

Egalitarianism and the Justificatory Community

The divergence between Rawls and Cohen is not merely a difference in perspective. It reflects a deeper opposition between the justificatory community and radical luck egalitarianism. Rawls's well-ordered society implicitly presupposes a justificatory community, that is, a society in which everyone accepts, and knows that others accept, the same principles of justice, and in which the basic institutions generally satisfy, and are generally known to satisfy, those principles

(Rawls, 2009, p. 5). This means that institutional arrangements must be capable of public justification to all, and that individual conduct must broadly accord with a shared sense of justice.

Cohen's project as a radical luck egalitarian moves in another direction. Its guiding ambition is to eliminate all involuntary disadvantage, and this ambition is in tension with the justificatory community at the level of justificatory structure itself. As Chen and Wang (2025) argue, justificatory community and luck egalitarianism adopt two different modes of justification: the former uses a second-personal mode, while the latter uses a third-personal mode. Second-person justification emphasizes mutual justification among persons: principles of justice must be acceptable in face-to-face terms to each social member, and persons stand in relations of reciprocal accountability. Third-person justification, by contrast, treats justice as an objective standard independent of interpersonal acceptance. This is precisely the logic of Cohen's luck egalitarianism. The two modes are hard to reconcile because their criteria are mutually exclusive. A justificatory community emphasizes what persons can actually accept from one another, but such intersubjective consensus may drift away from objective fairness. Luck egalitarianism emphasizes compensation in accordance with objective moral principle, but those affected may not be able to accept that principle from within their own social standpoint.

To display the contrast more clearly, Anderson (2010) famously proposes the case of Salieri and Mozart. Both love music and both work hard, but Mozart possesses extraordinary natural talent while Salieri does not. From a luck-egalitarian perspective, one may judge from an objective third-person standpoint that Salieri's resentment is not wholly groundless, because Mozart's superior gift is a matter of brute luck and such natural inequality is in one sense unfair. From the standpoint of the justificatory community, however, Salieri cannot justify his hatred to Mozart himself, because Mozart has done nothing wrong. He is simply more gifted, and to resent

an innocent person in that way violates the relation of equal respect that should hold between persons. Put simply, Cohen is concerned that people should not bear injustice because of luck, whereas Rawls attaches greater weight to public justification and shared social consensus. Their conceptions of equality are therefore theoretically incompatible, and this incompatibility brings their distinct paths sharply into focus.

Theoretical Value and Practical Implications

Theoretical Value

The comparison between Rawls and Cohen clarifies two different but complementary ways of understanding equality. In order to eliminate the deep inequalities produced by congenital and arbitrary factors, Rawls proceeds from the basic structure of society and, through the two principles of justice, seeks to improve the living conditions of the least advantaged without sacrificing equal liberty. Cohen moves further. He criticizes the tacit assumption of selfish human motivation built into Rawls's interpretation of the difference principle and argues that equality must penetrate ordinary personal choice in order to prevent vice in the private sphere from corroding just public institutions. Rawls's path is more realistic and easier to implement, but precisely because it accommodates self-interest to a greater extent, it risks permitting widening gaps that may eventually undermine the ideal of a well-ordered society. Cohen, by contrast, emphasizes that noncoercive factors such as family and social custom also shape people's prospects, and he highlights the importance of cultivating social ethos and shared commitment. In this way he both extends and, in his own view, rescues Rawls's theory of justice. Yet because his account relies heavily on the exercise of generosity, many scholars regard it as excessively idealistic. Their contrast shows that an egalitarian society needs the dual support of

institutional justice and personal choice. This expands both the content and the range of egalitarian practice.

The comparison also reveals a deeper tension internal to egalitarian theory itself. In arguing for the difference principle, Rawls hints at a justificatory community grounded in reciprocity and solidarity. At the same time, by compensating the least advantaged for inequalities rooted in talent and other natural contingencies, he also seems to adopt part of the logic of luck egalitarianism. Later studies suggest that these two commitments are difficult to sustain simultaneously: the responsibility-tracking logic of luck egalitarianism may erode the reciprocal foundation on which community depends, while a genuine justificatory community cannot fully accept a cold calculus of responsibility. Equality therefore oscillates between two different ideals—one as a mechanism of compensatory distribution and the other as a substantive ideal of social relationship. Drawing on Marx’s idea of stages of social development, Chen (2023) proposes a reconciliation: luck egalitarianism can function as the distributive principle appropriate to actual society, correcting congenital inequalities, whereas the justificatory community can be treated as a higher-stage value ideal shaping reciprocal and shared social relations. Under this interpretation, the two are not simply exclusive alternatives, but can be pursued in stages and thereby rendered partially compatible.

Practical Implications

The debate between Rawls and Cohen also offers important theoretical resources for China’s pursuit of common prosperity under conditions of high-quality development. Rawls seeks to correct the effects of natural and arbitrary factors through institutional justice, and this broadly aligns with China’s efforts to improve the distributive system and advance equalization in basic public services. Cohen’s critique, however, reminds us that even a complete institutional

framework may lose effectiveness if it lacks support at the level of social psychology and public ethos. If a society tacitly tolerates privilege, then formal equality of opportunity will be unable to translate into substantive equality of outcome. Institutional construction is therefore indispensable, but so is the removal of the invisible barriers embedded in social interaction, so that institutions can truly take effect in lived reality.

At the same time, Cohen's emphasis on the community principle prompts reflection on the way excessive material incentives may corrode social fairness. Policy design must therefore confront the problem of how to balance efficiency with equality. Common prosperity is not only an economic objective but also a condition of social relationship. It requires the cultivation of reciprocity, solidarity, and public-mindedness. As Engels once noted, the real content of the proletarian demand for equality is the abolition of class; any demand for equality that goes beyond or departs from this horizon easily becomes absurd (Marx & Engels, 2009, p. 113). This reminder suggests that China's egalitarian practice cannot simply copy Western theoretical routes. It must proceed from its own fundamental goals and, on the basis of institutional refinement and social solidarity, maintain a clear orientation toward communism.

Conclusion

This study clarifies the main division between two major theories of equality. It confirms the foundational role of institutions in underwriting justice, while also emphasizing the supplementary value of communal spirit. Justice, on this account, requires attention both to institutional guarantees and to individual choice. The comparison also shows that self-interested motivation should remain an object of vigilance. In that respect, the argument is consistent with the socialist aim of eliminating excessive inequality and may offer theoretical resources for the construction of social fairness.

Because of the scope and complexity of both Rawls's and Cohen's theories, this study has not been able to reconstruct every dimension of Cohen's egalitarian thought in a fully comprehensive way. The depth of analysis therefore remains limited in some respects. Future research may further examine the value balance between freedom and equality and explore more concrete and feasible ways of coordinating the two, thereby continuing to unfold the contemporary significance of egalitarian theory.

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