Research on Factors Influencing the Effectiveness of the "Dual-Collaboration" Graduate Training Model: An Analysis Based on a Tripartite Perspective

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Abstract: The traditional educational model, confined to within the school, overlooks the valuable contributions of social resources and practical experience. This limits its alignment with the modern demands for diverse talents, innovation, and comprehensive competencies. This study explores the "dual-collaboration model" in the cultivation of postgraduate students, which involves the collaborative training of university and enterprise instructors. The research examines the influencing factors and enhancement strategies for the practical validity of this model. First, questionnaires were used to assess the application effects of the dual-collaboration model from the perspectives of university instructors, enterprise instructors, and postgraduate students. Next, SPSS software was employed to analyze the main factors affecting the practical validity of the model. The study found that university instructors identified teaching challenges, teaching goals in the dimension of teaching experience, and experience sharing, as well as active learning in the dimension of student development, as significant factors for enhancing practical validity. Enterprise instructors emphasized that innovation development in the dimension of enterprise development, attitude improvement, and resource sharing and project cooperation in the dimension of university-enterprise collaboration would enhance practical validity. Postgraduate students believed that positive changes through staged learning, mentor influence, comprehensive development in terms of abilities, and social responsibility are factors that positively impact the practical validity of the dual-collaboration model. Based on these findings, the study proposes targeted enhancement strategies from three perspectives to improve the practical validity of the dual-collaboration model.

Keywords: Dual-Collaboration Model; Practical Validity; Influencing Factors; Enhancement Strategies; Postgraduate Education

1. Introduction

The Ministry of Education of China has issued the policy document Opinions of the Ministry of Education on Deepening the Classified Development of Academic and Professional Degree Graduate Education, which emphasizes that contemporary postgraduate education should no longer be dominated by theoretical instruction alone, but instead be deeply integrated into industry practice. Traditional educational models are often confined within universities, neglecting the critical role of social resources and practical experience in students' holistic development. Such a singular training approach is insufficient to meet the diversified demands for talent in the new era, particularly in terms of cultivating students' practical skills, innovative capacity, and comprehensive competencies.

Against this background, the dual-collaboration education model has emerged as an innovative approach that effectively integrates academic and social resources. This model highlights close cooperation between universities and enterprises and seeks to cultivate high-quality talents with strong innovative abilities and practical skills through the organic integration of theory and practice. The dual-collaboration model not only provides students with richer learning resources and practical opportunities, but also creates a mutually beneficial development framework for educational institutions and enterprises.

In practical implementation, the dual-collaboration model operates through

university–enterprise collaboration, whereby graduate students are jointly supervised by both academic advisors and enterprise mentors. University–enterprise collaboration leverages the respective strengths of universities and enterprises by jointly formulating training programs and conducting collaborative teaching and research projects. Under the dual-mentor system, academic advisors are primarily responsible for theoretical instruction, while enterprise mentors focus on practical training, thereby ensuring a close alignment between educational content and real-world demands.

However, the practical effectiveness of the dual-collaboration model may be influenced by multiple factors, including students' learning stages and the impact of mentors; the depth of university–enterprise cooperation, its potential benefits for enterprises, and the teaching challenges faced by instructors. Which specific factors exert substantive influences on the effectiveness of the dual-collaboration model remains an issue that requires further investigation. Therefore, this study aims to systematically analyze the influencing factors of the practical effectiveness of the dual-collaboration model from the perspectives of universities, enterprises, and students, and to propose corresponding improvement strategies, thereby providing theoretical support and practical guidance for the promotion and optimization of this model.

2. Literature Review

Social constructivist learning theory emphasizes that the development of individual cognition is achieved through social interaction and contextual participation. In the field of education, this theory highlights the social and situational nature of learning, arguing that knowledge is not merely transmitted, but rather co-constructed through collaboration and communication with others[1]. Recent studies have not only deepened the theoretical understanding of social constructivism, but have also empirically validated its effectiveness in educational practice. From a theoretical perspective, students' cognitive development can be effectively enhanced through guided engagement in interactive learning activities[2]. Empirical studies, through case analyses and field experiments, have further demonstrated the application of social constructivism across diverse educational contexts, including collaborative education, team-based projects, and dialogic teaching[3-4].In summary, because social constructivism places particular emphasis on the practical role of contextual learning and cooperative relationships, it has been widely applied to collaborative instructional models characterized by practice-oriented and interaction-based learning.

Postgraduate education serves as a cornerstone of social development and a source of future potential. It is not only a crucial pathway for knowledge transmission and skills cultivation, but also a key stage for character development and the stimulation of innovation[5]. By promoting the comprehensive development of students' cognitive, emotional, social, and practical abilities, postgraduate education can enhance students' overall competencies while also contributing to sustained social progress and civilizational advancement[6].However, traditional postgraduate education systems tend to overlook opportunities for off-campus practice and diversified development, resulting in students' inability to fully enhance essential capabilities such as practical skills, innovative capacity, and comprehensive competencies[7]. This urgent demand for the holistic development of postgraduate students has given rise to the dual-collaboration model.

A collaborative and innovative approach to talent cultivation in higher education, known as the dual-collaboration education model, has emerged within the university context[8]. This model emphasizes deep cooperation between universities and enterprises in order to achieve a seamless integration of theory and practice[9]. In China, the implementation of dual-collaboration education has primarily focused on innovation and entrepreneurship education as well as ideological and political education, with its main target groups being students in vocational institutions and enrolled postgraduate students[10]. For postgraduate students, in addition to conducting specialized academic research, it is essential to develop innovative practical abilities and sound comprehensive competencies to cope with future career challenges[11]. Regarding the implementation mechanisms of the dual-collaboration model, university–enterprise collaboration and the dual-mentor system have received the greatest attention in educational research. University–enterprise collaboration highlights close cooperation between universities and

enterprises through jointly formulating training programs, conducting practice-oriented teaching, sharing educational resources, and participating in research projects. In this way, both parties can leverage their respective strengths in talent cultivation, thereby enhancing students' practical capabilities and employability[12].

Throughout the entire process of postgraduate education, supervisors play an irreplaceable role as key responsible actors[13]. Empirical studies indicate that mentors, through conceptual transformation, student-centered approaches, and rigorous management, exert a significant influence on the improvement of postgraduate students' professional competence, psychological resilience, and ideological and moral development[14-15]. Consequently, many scholars have advocated the dual-mentor system. The dual-mentor system refers to a training arrangement in which students are jointly supervised by two mentors from universities and enterprises: academic mentors are responsible for theoretical instruction and academic research guidance, while enterprise mentors focus on practical skills training and the enhancement of professional competence. Through this arrangement, the organic integration of theory and practice is achieved, thereby comprehensively improving students' overall competencies and career adaptability[16].

At present, the dual-mentor system has become the primary implementation pathway of the dual-collaboration model. With respect to the influencing factors of the dual-collaboration model, existing studies suggest that the practical effectiveness of dual-collaboration education is mainly affected by students' self-directed learning ability[17], the rationality of curriculum design[18], the level of enterprise participation[19], and teachers' practical competence[20]. Some scholars further argue that enterprises' investment of resources and their willingness to collaborate constitute key determinants of successful implementation[21]. In addition, enhancing teachers' practical competence through regular training programs and exchanges with enterprise mentors can significantly improve teaching quality under the dual-collaboration framework[22].

In summary, the dual-collaboration model has emerged as an emerging trend in contemporary higher education, and the dual-mentor system, as a key implementation pathway of this model, warrants particular attention. However, existing research on the influencing factors of the dual-collaboration model remains insufficient. In particular, there is a lack of comprehensive evaluation of its practical effectiveness from the perspectives of universities, enterprises, and students as three key stakeholders. Therefore, further in-depth investigation in this field is necessary to provide more systematic and accurate theoretical insights and practical guidance.

3. Research Methods and Design

3.1 Research Methods

This study first conducts a systematic review and synthesis of existing literature to refine questionnaire items, followed by the distribution of questionnaires for data collection. Subsequently, SPSS software is employed to evaluate the practical effectiveness of the dual-collaboration model from the perspectives of university instructors, enterprise mentors, and postgraduate students. The questionnaire design incorporates items measured using a five-point Likert scale, with the aim of quantitatively assessing the practical effectiveness of the dual-collaboration model.

3.2 Research Design

First, the questionnaire survey sample was determined. The target population comprised university instructors, enterprise mentors, and postgraduate students from relevant disciplines, drawn from ten universities and five cooperating enterprises in Shanghai. The questionnaire for university instructors consisted of four sections: personal attributes, teaching, collaboration, and effectiveness. The questionnaire for enterprise mentors included personal attributes, enterprise development, student cultivation, and effectiveness. The postgraduate student questionnaire comprised four sections: personal attributes, staged learning, ability development, and effectiveness. A total of 300 questionnaires were distributed. After excluding 76 invalid responses, 224 valid questionnaires were obtained, including 88 from university instructors, 67 from enterprise mentors, and 69 from postgraduate students.

3.3 Sample Description

SPSS statistical analysis software was used to conduct descriptive statistical analyses of university instructors, enterprise mentors, and

postgraduate students. Based on the questionnaire data, the survey items were further refined to clarify the research indicators (Table 1). Among university instructors, the gender distribution was relatively balanced, with most respondents concentrated in the 40–50 age group. Approximately 94% held doctoral degrees, a relatively high proportion possessed associate senior professional titles, and the majority had no more than three years of teaching experience under the dual-collaboration model. Among enterprise mentors, the gender distribution was also relatively balanced, with most respondents aged between 30–40 and 40–50 years. About 97% held at least a bachelor's degree, and similarly, most had three years or less of experience participating in the dual-collaboration model. Among postgraduate students, the gender distribution was balanced, with second-year master's students accounting for the largest proportion.

Table 1. Research Indicators and Their Definitions

Research Subject	Research Indicator	Indicator Definition
University Instructors	Teaching Experience	Teaching experience refers to the perceptions, experiences, and feedback that instructors encounter during the teaching process. It encompasses the challenges faced, the goals established, and the specific implementation of teaching activities, and it serves as an important basis for evaluating teaching quality and learning outcomes.
	Student Development	Student development refers to the comprehensive cultivation of students' knowledge, abilities, and attitudes through experience sharing, quality enhancement, and the encouragement of active learning, enabling students to achieve healthy growth and sustainable development in academic, social, and personal domains.
	Effectiveness	From the perspective of university instructors, the effectiveness of the dual-collaboration model refers to the extent to which instructors can effectively enhance the efficiency of student supervision during the teaching process.
Enterprise Mentors	Enterprise Development	Enterprise development refers to the process by which organizations achieve sustained growth and progress in competitive environments through innovation development, experiential learning, access to resource support, and the enhancement of organizational members' attitudes.
	Effectiveness	From the perspective of enterprise mentors, the effectiveness of the dual-collaboration model refers to the perceived positive effects of the model on enterprises in terms of innovation development, talent recruitment, and multi-dimensional resource acquisition.
Postgraduate Students	Staged Learning	Staged learning refers to the learning process under the dual-collaboration model, characterized by positive changes, the integration of theory and practice, mentor influence, and the reception of ideological and political education.
	Ability Development	Ability development refers to the process of cultivating and enhancing professional skills and managerial competencies at different stages, exploring and planning career pathways, and assuming social responsibility.
	Effectiveness	From the perspective of postgraduate students, the effectiveness of the dual-collaboration model refers to students' perceptions that the model provides significant improvements over traditional approaches in both theoretical learning and practical training.

4. Analysis of Factors Influencing the Practical Effectiveness of the Dual-Collaboration Model

4.1 Reliability and Validity Analysis of the Questionnaire

The reliability and validity of the questionnaire were examined using Cronbach's alpha coefficients and Bartlett's test of sphericity approximate chi-square. For the university instructor questionnaire, the Cronbach's alpha value of the teaching experience scale was 0.716, which falls between 0.7 and 0.8, indicating acceptable reliability. The KMO value was 0.716, exceeding the recommended threshold of 0.7, suggesting that the data were suitable for factor analysis. Bartlett's test of sphericity yielded an

approximate chi-square value of 56.25 with 3 degrees of freedom (df), and the result was statistically significant (p = 0.000). For the student development scale, the Cronbach's alpha coefficient was 0.815, which lies between 0.8 and 0.9, indicating good reliability. The KMO value was 0.696, close to 0.7 and considered acceptable for factor analysis. Bartlett's test of sphericity produced an approximate chi-square value of 91.68 with 3 degrees of freedom (df), and the result was statistically significant (p = 0.000).

For the enterprise mentor questionnaire, the Cronbach's alpha coefficient of the enterprise development scale was 0.765, which falls between 0.7 and 0.8, indicating acceptable reliability. The KMO value was 0.724, exceeding the recommended threshold of 0.7, suggesting that the data were suitable for factor analysis. Bartlett's test of sphericity yielded an approximate chi-square value of 77.239 with 6 degrees of freedom (df), and the result was statistically significant (p = 0.000).

For the postgraduate student questionnaire, the Cronbach's alpha coefficient of the student development scale was 0.815, which falls between 0.8 and 0.9, indicating good reliability. The KMO value was 0.753, exceeding the recommended threshold of 0.7, suggesting that the data were suitable for factor analysis. Bartlett's test of sphericity produced an approximate chi-square value of 95.619 with 6 degrees of freedom (df), and the result was statistically significant (p = 0.000).

4.2 Regression Analysis of Factors Influencing the Effectiveness of the Dual-Collaboration Model

Based on the collected questionnaire data, SPSS software was employed to analyze the factors influencing the effectiveness of the dual-collaboration model from the perspectives of university instructors, enterprise mentors, and postgraduate students. For university instructors, teaching experience [23] and student development [24] were treated as independent variables. For enterprise mentors, enterprise development [25] and university–enterprise collaboration [26] were specified as independent variables. For postgraduate students, staged learning [27] and ability development [28] were used as independent variables. In all models, effectiveness served as the dependent variable. Specifically, the dependent variables corresponded to the effectiveness of instructional supervision for university instructors, the perceived effectiveness of the dual-collaboration model for enterprise mentors, and the effectiveness of student learning outcomes for postgraduate students.

4.2.1 University instructors

Based on the regression results for university instructors presented in Table 2, both teaching experience and student development exhibit significant influencing factors on the effectiveness of the dual-collaboration model.

(1)Teaching challenges and teaching objectives exert significant positive effects on the effectiveness of the dual-collaboration model

The results indicate that teaching objectives have a significant positive effect on the effectiveness of the dual-collaboration model at the 5% significance level, with a coefficient of 3.036. Clearly defined teaching objectives provide university instructors with explicit direction, enabling them to design targeted instructional strategies and adjust course content accordingly. Moreover, well-articulated objectives can stimulate instructors' teaching enthusiasm and innovative awareness, thereby contributing to the overall improvement of teaching quality. In addition, teaching challenges show a significant positive effect at the 10% significance level, with a coefficient of 1.995. When confronted with challenges, university instructors are able to continuously refine their teaching methods and adapt to evolving instructional environments, thereby enhancing overall teaching quality and students' practical competencies.

Table 2. Regression Results of Factors Influencing the Effectiveness of the Dual-Collaboration Model among University Instructors

University Instructor Indicators	Variables	Effectiveness		Effectiveness		Effectiveness	
		Beta	t	Beta	t	Beta	t
Personal Attributes	Gender	-0.142	-1.304	-0.026	-0.275	-0.022	-0.226
	Age	0.238	2.238	0.195	2.179	0.198	2.230
	Educational Level	0.033	0.304	0.016	0.177	0.059	0.653
	Professional Title	-0.101	-0.933	-0.109	-1.214	-0.173	-1.939
	Teaching Experience under the	-0.130	-1.217	-0.061	-0.670	-0.026	-0.290

	Dual-Collaboration Model						
Teaching Experience	Teaching Challenges			0.232	1.995*		
	Teaching Objectives			0.311	3.036**		
	Teaching Process			0.166	1.507		
Student Development	Experience Sharing					0.273	2.302*
	Quality Enhancement					0.169	1.320
	Active Learning					0.253	2.022*
	F	1.682		6.541		6.809	
	R^2	0.093		0.398		0.408	

Note: ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

(2)Experience sharing and active learning exert significant positive effects on the practical effectiveness of the dual-collaboration model

Within the dimension of student development, experience sharing demonstrates a positive and statistically significant effect on the practical effectiveness of the dual-collaboration model at the 10% significance level, with a coefficient of 0.254. Experience sharing serves as an effective means of helping students rapidly adapt to new learning environments and acquire foundational competencies. Through guidance by example and explicit instruction, university instructors can assist students in better understanding and applying acquired knowledge, thereby enhancing their academic performance. Furthermore, active learning within the student development dimension exhibits a positive and statistically significant effect on the practical effectiveness of the dual-collaboration model at the 1% significance level, with a coefficient of 0.426. By providing active guidance and encouragement, university instructors help students establish appropriate learning attitudes and strengthen their capacity for self-directed learning and learning motivation, which in turn leads to improved learning outcomes.

4.2.2 Enterprise mentors

Table 3. Regression Results of Factors Influencing the Practical Effectiveness of the Dual-Collaboration Model among Enterprise Mentors

Enterprise Mentor Indicators	Variables	Effectiveness		Effectiveness		Effectiveness	
		Beta	t	Beta	t	Beta	t
Personal Attributes	Gender	0.226	1.745	0.096	1.102	0.168	2.240
	Age	0.084	0.654	0.060	0.704	0.139	1.922
	Educational Level	-0.121	-0.972	-0.020	-0.239	-0.107	-1.496
	Teaching Experience under the Dual-Collaboration Model	-0.148	-1.203	-0.066	-0.780	-0.088	-1.255
Enterprise Development	Innovation Development			0.348	2.862**		
	Experience Acquisition			0.252	2.280		
	Cost Optimization			0.106	0.899		
	Attitude Enhancement			0.299	3.438**		
University–Enterprise Collaboration	Resource Sharing					0.254	2.465*
	Faculty Exchange					0.117	1.383
	Project Collaboration					0.426	4.523***
	Institutional Support					0.186	1.815
	F	1.186		12.289		19.156	
	R^2	0.071		0.629		0.725	

Note: ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

Based on the regression results for enterprise mentors presented in Table 3, both enterprise development and university–enterprise collaboration exhibit significant influencing factors on the practical effectiveness of the dual-collaboration model.

(1)Innovation development and attitude enhancement exert significant positive effects on the practical effectiveness of the dual-collaboration model

Within the dimension of enterprise development, innovation development shows a significant positive effect on the practical effectiveness of the dual-collaboration model at the 5% level, with a coefficient of 0.348. Innovation-driven development provides enterprise mentors with abundant teaching resources and project opportunities, which not only enhances the practicality and frontier nature of teaching content but also stimulates mentors' innovative awareness and teaching enthusiasm, thereby further improving teaching effectiveness. In

addition, attitude enhancement within enterprise development has a significant positive effect on the practical effectiveness of the dual-collaboration model at the 5% level, with a coefficient of 0.299. Through maintaining a positive teaching attitude, enterprise mentors are better able to transmit knowledge and skills, stimulate students' learning interest and motivation, and ultimately improve overall teaching effectiveness.

(2)Resource sharing and project collaboration exert significant positive effects on the practical effectiveness of the dual-collaboration model

Resource sharing demonstrates a significant positive effect on the practical effectiveness of the dual-collaboration model at the 10% level, with a coefficient of 2.302. Its influence is mainly reflected in the optimization of teaching resource allocation, which helps avoid resource waste, reduce costs, and promote knowledge updating and skill enhancement among mentors from both universities and enterprises, thereby providing students with higher-quality educational services. Similarly, project collaboration shows a significant positive effect on the practical effectiveness of the dual-collaboration model at the 10% level, with a coefficient of 2.022. Through the joint design and implementation of projects by university instructors and enterprise mentors, theory and practice can be deeply integrated, improving teaching efficiency and quality while strengthening the integration of industry, academia, and research, and offering students more practical learning opportunities.

4.2.3 Postgraduate students

Table 4. Regression Results of Factors Influencing the Practical Effectiveness of the Dual-Collaboration Model among Postgraduate Students

Postgraduate Student Indicators	Variables	Effectiveness		Effectiveness		Effectiveness	
		Beta	t	Beta	t	Beta	t
Personal Attributes	Gender	-0.044	-0.220	0.131	1.528	-0.175	-1.964
	Grade	0.118	0.591	-0.059	-0.682	-0.022	-0.262
Stage-Based Learning	Learning Process			0.318	3.704**		
	Integration of Theory and Practice			0.082	0.948		
	Mentor Influence			1.017	7.176***		
	Ideological and Political Education			-0.119	-0.860		
Competency Development	Academic Competence					0.184	1.893
	Comprehensive Development					0.300	2.644*
	Career Path Development					0.017	0.175
	Social Responsibility					0.603	4.549***
	F	0.184		21.306		20.797	
	R^2	0.015		0.859		0.856	

Note: ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

Based on the regression results for postgraduate students presented in Table 4, both stage-based learning and competency development exhibit significant influencing factors on the practical effectiveness of the dual-collaboration model.

(1)The learning process and mentor influence exert significant positive effects on the practical effectiveness of the dual-collaboration model

The learning process shows a significant positive effect on the practical effectiveness of the dual-collaboration model at the 5% level, with a coefficient of 0.318. During the training process, postgraduate students, through active learning and proactive participation, are able to acquire theoretical knowledge and apply it to practical work, thereby enhancing their overall competencies. Mentor influence exerts a significant positive effect on postgraduate students' learning effectiveness at the 1% level, with a coefficient of 1.017. Through mentors' guidance and support, postgraduate students are better able to understand and master disciplinary knowledge, while also receiving necessary assistance and encouragement when facing difficulties and challenges, which further improves their learning outcomes.

(2)Comprehensive development and social responsibility exert significant positive effects on the practical effectiveness of the dual-collaboration model

Comprehensive development has a significant positive effect on the effectiveness of the

dual-collaboration model at the 10% level, with a coefficient of 0.300. By emphasizing the integrated development of professional competencies, moral qualities, and a sense of social responsibility, postgraduate students are better able to adapt to societal demands and enhance their overall quality and competitiveness. Social responsibility shows a significant positive effect on postgraduate students' learning effectiveness at the 1% level, with a coefficient of 0.603. Through engagement with real-world problems and social needs, postgraduate students can strengthen their awareness of and commitment to social responsibility, improve their ability to address practical issues, and further enhance the effectiveness of the dual-collaboration model.

5. Conclusion

First, for university instructors, both teaching objectives and teaching challenges exert significant positive effects on the practical effectiveness of the dual-collaboration model, with teaching objectives showing a particularly strong influence. Clear teaching objectives not only provide instructors with direction and motivation, enabling them to systematically plan courses and teaching content, but also stimulate students' learning interest and engagement, thereby ensuring the smooth implementation of teaching tasks. In addition, complex teaching challenges encourage university instructors to continuously enhance their problem-solving abilities and instructional skills, enabling them to respond more effectively to real-world issues and improve overall teaching quality. Moreover, experience transmission and active learning also have significant positive effects on the practical effectiveness of the dual-collaboration model, with active learning being especially influential. Experience transmission serves as an effective approach to help students quickly adapt to new learning environments; through demonstration and guidance, university instructors enable students to more rapidly understand and master professional knowledge. Cultivating students' active learning attitudes is central to promoting autonomous learning. Through proactive guidance and encouragement, instructors can help students develop appropriate learning perspectives, enhance learning initiative and motivation, and ultimately improve learning outcomes.

Second, for enterprise mentors, within the dimension of enterprise development, both innovation development and attitude enhancement exert significant positive effects on the practical effectiveness of the dual-collaboration model. Innovation-driven enterprise development not only provides enterprise mentors with abundant teaching resources and project opportunities, making instructional content more closely aligned with practical applications and frontier technologies, but also stimulates mentors' own innovative thinking and teaching enthusiasm. An innovation-oriented development environment prompts enterprise mentors to continuously explore new instructional methods and approaches, thereby improving teaching effectiveness. A positive teaching attitude among enterprise mentors is also crucial to ensuring the smooth implementation of instructional activities, as it not only facilitates more effective knowledge transfer but also influences students' learning attitudes and motivation. In addition, resource sharing and project collaboration have significant positive effects on the practical effectiveness of the dual-collaboration model. Through resource sharing, enterprise mentors can optimize the allocation of teaching resources, avoid redundant efforts and resource waste, and promote knowledge exchange with university instructors. Project collaboration further strengthens interaction between enterprise mentors and university instructors, fosters closer collaborative relationships, enhances teaching quality, and provides students with more practical opportunities and authentic project experience.

Third, for postgraduate students, the findings indicate that within the dimension of stage-based learning, both the learning process and mentor influence have significant positive effects on the practical effectiveness of the dual-collaboration model, with mentor influence being particularly prominent. Through active and proactive learning, postgraduate students are able not only to remain more focused during the learning process but also to develop sound learning habits and modes of thinking. Mentor influence plays a crucial role in postgraduate education, as mentors not only transmit professional knowledge and skills but also shape students' values and professional ethics through guidance by example. Mentors' instruction and support help postgraduate students better understand and master disciplinary knowledge, while also

providing necessary assistance and encouragement when they encounter difficulties and challenges. Within the dimension of competency development, both comprehensive development and social responsibility exert significant positive effects on the practical effectiveness of the dual-collaboration model, with social responsibility showing a particularly strong influence. Comprehensive development extends beyond the enhancement of professional competencies to include the improvement of moral qualities and a sense of social responsibility. Through participation in enterprise projects, postgraduate students are exposed to more practical problems and societal demands, which strengthens their awareness and commitment to social responsibility, cultivates their ability to address practical issues, and ultimately promotes their holistic development.

6. Policy Recommendations

First, strengthen top-level national planning for the dual-collaboration model. China should remain committed to the development of the dual-collaboration model by formulating a unified policy framework and implementation guidelines. The importance of the dual-collaboration model in postgraduate education should be clearly articulated and incorporated into the long-term national plan for educational development. It is recommended that dedicated funding programs be established to support teaching and research collaboration between universities and enterprises under the dual-collaboration framework, and to encourage the application for interdisciplinary and cross-sector projects. Through policy guidance and financial support, deeper cooperation between universities and enterprises in collaborative talent cultivation can be promoted. At the same time, a national-level evaluation mechanism should be established to regularly assess the implementation effectiveness of the dual-collaboration model, with policies adjusted and optimized in accordance with evaluation outcomes.

Second, improve the university–enterprise teaching competency evaluation system. Universities and enterprises should jointly develop evaluation criteria for teachers' instructional competencies, taking into comprehensive consideration their academic qualifications, teaching abilities, practical experience, and collaborative attitudes. It is recommended that third-party evaluation agencies be introduced to conduct objective and impartial assessments of teachers' teaching performance and collaborative outcomes. The evaluation criteria should encompass multiple dimensions, including actual teaching effectiveness under the dual-collaboration model, research outputs, and student feedback. Through a well-established evaluation mechanism, teachers can be encouraged to continuously enhance their instructional capabilities and collaborative competencies, thereby ensuring the effective implementation of the dual-collaboration model. At the same time, evaluation results should be linked to teachers' career development, promotion, and reward systems, forming a sustainable incentive mechanism.

Third, deepen university–enterprise collaborative mechanisms. Building upon existing partnerships, universities and enterprises should further expand and enrich the content and forms of collaboration. It is recommended that joint research centers or laboratories be established to conduct collaborative research on social priority issues and frontier technologies. University instructors and enterprise mentors should engage in regular mutual visits and exchanges to share teaching experiences and research outcomes. Enterprises can also provide more practical projects and internship opportunities, enabling postgraduate students to enhance their professional competencies and sense of social responsibility through real-world engagement. Through institutionalized collaboration mechanisms, universities and enterprises can achieve deeper integration in talent cultivation and research innovation, thereby jointly improving the practical effectiveness of the dual-collaboration model.

Fourth, enhance participation motivation at the individual level. To increase the engagement of university instructors, enterprise mentors, and postgraduate students in the dual-collaboration model, multifaceted approaches should be adopted. First, universities and enterprises should strengthen the dissemination and promotion of the dual-collaboration model to ensure that all stakeholders fully understand its significance and advantages. Second, incentive mechanisms should be established to reward and recognize instructors and students who demonstrate outstanding performance within the dual-collaboration framework. In addition,

training programs and exchange activities related to the dual-collaboration model should be organized to enhance participants' enthusiasm and capacity for engagement. Through these combined measures, the awareness and motivation of university instructors, enterprise mentors, and postgraduate students can be strengthened, thereby ensuring the smooth implementation and sustainable development of the dual-collaboration model.

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