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Original Article

Bridging the Gap: An Analysis of Key Factors Driving Industry-Education Integration in Application-Oriented Undergraduate Institutions

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Abstract:
Industry-education integration (IEI) has emerged as a crucial strategy in China's higher education reform, particularly within application-oriented undergraduate institutions. Using Guangzhou as a case study, this research employed a mixed-methods approach, including questionnaires from 712 students and interviews with 10 teachers and corporate mentors, to examine multi-dimensional factors affecting IEI such as professional competence, employability, practical skills, motivation, participation modes, school satisfaction, and self-efficacy. Key findings include: (1) Professional competence and employability mutually reinforce each other, significantly enhancing student self-efficacy and challenging traditional linear views that treat self-efficacy primarily as a precursor to employment. (2) While students generally appreciate IEI initiatives, they highlight crucial shortcomings including a mismatch between educational content and industry requirements, limited variety in IEI models, and insufficient enterprise participation. These insights underscore policy implementation gaps and the need for increased incentives for enterprise involvement.

Keywords: industry-education integration, self-efficacy, student satisfaction, motivation

1. Introduction

Industry-education integration (IEI) is increasingly recognized as a vital strategy for aligning higher education with rapidly evolving labor market needs, particularly within vocational and application-oriented undergraduate institutions. This integration is not merely a contemporary trend but an essential response to the global economy's demand for skilled labor. Historically rooted in China's early work-study systems, IEI has significantly developed, especially following economic reforms, and is now central to vocational education policy and practice. The Chinese government actively promotes IEI through various supportive policies and legal frameworks aimed at enhancing the collaboration between academia and industry.

Despite widespread acknowledgment of its benefits, the practical implementation of IEI varies considerably across institutions. While IEI initiatives like co-construction of resources, order cultivation, and dual-system models have been broadly adopted, challenges remain in effectively integrating academic curricula with industry needs, especially in the context of the digital economy. Leveraging digital technologies to improve industry-education collaboration presents a promising but underexplored avenue.

This study seeks to address critical gaps in the existing literature by examining the effectiveness of IEI initiatives and identifying factors influencing their success or shortcomings. Specifically, the research explores: (1) the

alignment between higher education curricula and the actual skills demanded by employers; (2) barriers to integrating industry-generated content with academic teaching materials; and (3) practical challenges encountered during the implementation of IEI.

Employing a mixed-methods approach, the study uses Guangzhou—a national pilot city for IEI—as its focal context, gathering insights from students, educators, and corporate mentors. By thoroughly investigating stakeholder experiences and perceptions, the study aims to identify significant determinants of successful integration and recommend practical strategies to enhance IEI effectiveness, thereby informing policy and practice in vocational education both within China and internationally.

Literature Review of Integration of Industry and Education

Industry-education integration (IEI) is a strategic educational approach developed to bridge the gap between academic knowledge and practical industry needs. Originating in Europe, this model emphasizes an enterprise-led, school-supported framework, fostering close cooperation between academic institutions and industry sectors[1.] Philip J. Foster further advanced this concept by emphasizing a comprehensive collaboration among industry, education, and research institutions. Globally recognized, IEI aims to address structural mismatches between educational outcomes and industry demands, thus promoting robust economic development and innovation.

In China, IEI evolved from initial "work-study" programs into more sophisticated frameworks combining academic instruction with practical enterprise experiences. Various effective models have emerged, including "professional teaching combined with campus demonstration bases," "key disciplines paired with school-run enterprises," "fixed-point enterprise internships," and "joint education initiatives" [1] These models have significantly influenced the direction of vocational education reform in China[2].

Despite policy support from China's Ministry of Education, institutions face diverse challenges such as superficial cooperation, limited variety in collaboration formats, insufficient enterprise motivation, inadequate infrastructure, constrained teaching schedules, uneven student abilities, and insufficient training and support for educators[3].

Determinants of integration outcomes

Student Perceptions of Industry-Education Integration

Research underscores the importance of student perceptions in successfully implementing IEI programs, particularly in enhancing employability and job satisfaction[4-5]. Blended learning methods offer students adaptable educational experiences, significantly improving their vocational competencies[6]. Nevertheless, students frequently perceive gaps between academic curricula and workplace requirements, particularly pronounced in the Industry 4.0 context[7-8]. Practical work experiences, such as internships, substantially enhance students' professional skills and confidence[9-10]. Additionally, students often find academic teachers to provide better theoretical support and detailed feedback compared to industry practitioners who, although experienced, may lack teaching skills[11]. Participation in industry-relat- ed activities further clarifies career paths for students[10].

Teacher perceptions of industry-education integration

Teachers generally support IEI, acknowledging its benefits in enhancing student comprehension, practical application of knowledge, and overall engagement[12]. Integrating vocational and academic education provides a rigorous curriculum that aligns theory with practice. However, teachers frequently encounter limitations such as inadequate resources, limited time, and insufficient support, which negatively affect their confidence in effectively implementing IEI[13]. Teachers must continually update their skills and knowledge, especially to address the demands of Industry 4.0, thereby increasing student preparedness for the workforce[8]. Positive feedback from internship supervisors is also essential for boosting students' self-efficacy and professional growth [9,14].

Theoretical framework

The study's theoretical framework integrates several critical factors influencing IEI effectiveness: students' professional competencies, entrepreneurial skills, practical experiences, motivation, perceptions of IEI,

satisfaction, and self-efficacy. Professional competence encompasses academic expertise and technical abilities. Entrepreneurial skills include competencies necessary for business management, negotiation, marketing, finance, and law. Practical experiences relate to direct industry involvement through internships or entrepreneurial activities, significantly influencing entrepreneurial intentions[15].

Motivation

Motivation critically influences students' participation in IEI initiatives, affecting their time investment, persistence, and emotional engagement[16-17]. Effective motivation stimulates deeper learning and active engagement, directly enhancing educational outcomes[18-19]. Understanding student motivation provides valuable insights into their initial intentions and continued participation in IEI, thus guiding reforms to educational practices.

Student Satisfaction

Student satisfaction is integral for evaluating educational quality, significantly influencing student outcomes and perceptions of educational value[20-21]. Satisfaction is conceptualized as an evaluative outcome, directly linked to the effectiveness of educational service delivery[22]. High student satisfaction correlates with increased motivation, effort, and actionable engagement in learning activities[23,24].

At the foundation of this theoretical model lies behaviorist learning theory, highlighting the critical role of teaching and practical experiences in shaping student engagement and satisfaction. Enhanced self-efficacy, driven by effective teaching and practical application, further reinforces learning behaviors, creating a positive cycle of educational outcomes.

Thus, this comprehensive theoretical framework encapsulates dynamic interactions among curriculum design, practical training methodologies, and instructor roles, underpinning a robust ecosystem essential for successful IEI implementation.

Methodology

This study employed a mixed-methods design, incorporating both qualitative and quantitative approaches, to assess the effectiveness of IEI practices at a selected institution during the 2023-2024 academic year. Data were collected through structured questionnaires targeting undergraduate students and semi-structured interviews with corporate mentors and teachers.

Sample and Sampling

The qualitative component involved semi-structured interviews with enterprise mentors, exploring perceived shortcomings, underlying causes, and proposed improvements in IEI implementation. Additionally, a structured questionnaire was administered to undergraduate students, capturing feedback on their professional training, practical experiences, and IEI initiatives.

Data Analysis

The questionnaire encompasses several key dimensions, including professional competence, practical skills, employability, entrepreneurial intentions, industry-education integration models, self-efficacy, satisfaction levels, and suggestions for improvement. A total of 712 complete questionnaires were collected, and the details as the fellow table1.

Table 1. Questionnaire Content

Construct	Code	Item
Professional ability	PFC1	1.To what extent have you acquired proficiency in your professional knowledge?
	PFC2	2.During your academic journey, will there be opportunities to apply theoretical knowledge to practical problem-solving scenarios?
	PFC3	3. How beneficial do you believe the courses offered by the school are in enhancing your professional skills?
	PFC4	4. I plan to enroll in online courses recommended by my instructors.
	PFC5	5. Have you participated in any competitions or projects relevant to your field of study?

Employability	EPA1	1. To what degree do you anticipate that the professional knowledge and skills acquired will assist you in securing employment in the future?
	EPA2	2. How confident are you in finding a job that meets your expectations?
	EPA3	3. Do you have an interest in starting your own business or engaging in entrepreneurial projects in the future?
Practical Experience	PE1	1.How many internships or part-time jobs have you undertaken prior to this?
	PE2	2.In terms of project experience, which roles have had the most significant impact on your development?
	PE3	3. During your internship at the base, what was the most challenging technical skill issue you encountered?
	PE4	4. What specific skills or experiences have you gained from your internships or practical work?
Motivation		What is your primary motivation for participating in industry-education integration initiatives?
Opinions about industry-education integration	OP1	1.Which model of industry-education integration do you prefer?
	OP2	2. What challenges do you perceive in the education process of integrating industry and education?
	OP3	3. What issues do you identify with schools providing social services and integrating education between industry and academia?
Satisfaction and Suggestion	SA1	1. Please share your satisfaction level with the school's industry-education integration project and provide any suggestions for improvement.
	SA2	2. What measures do you believe could enhance the curriculum of colleges and universities?
Self-efficacy	SE1	1. I can face difficulties calmly because I trust in my ability to deal with them.
	SE2	2. I can participate in speeches and discussions in class very well.
	SE3	3. I can master professional skills well, as long as someone teaches me.
	SE4	4. Professional knowledge and skills are not difficult to master, as long as I want to learn.

Results

According to these seven factors, interviews of 10 teachers and a questionnaire survey was conducted among 712 undergraduates from Year 1 to 4, as shown in Table 2.

Table 2. Questionnaire Survey Results

Construct	Code	Positive	Neutral	Negative
Professional competence	PFC1	288(40.45%)	347(48.74%)	77(10.81%)
	PFC2	149(20.93%)	398(55.9%)	165(23.22%)
	PFC3	626(87.93%)	5(0.7%)	81(11.38%)
	PFC4	580(81.46%)	86(12.08%)	46 (6.46%)
	PFC5	358(50.28%)	0	354 (49.72%)
Employability.	EPA1	341(47.89%)	193(27.11%)	48 (6.72%)
	EPA2	259(36.38%)	341(47.89%)	112(15.73%)
	EPA3	382(53.65%)	240(33.71%)	90(12.64%)
Practical	PE	530(74.44%)	0	182(25.56%)

Experience				
Satisfaction	SA	133(18.68%)	464(65.17%)	115(16.15%)
Self-efficacy	SE1	387(54.35%)	273(38.34%)	52(7.3%)
	SE2	330(46.34%)	316(44.385%)	66(9.275%)
	SE3	436(61.23%)	231(32.44%)	75(6.32%)
	SE4	411(57.72%)	250(35.11%)	51(7.16%)

PE3 3. During your internship at the base, what was the most challenging technical skill issue you encountered?

Technical skills challenges account for 475 cases (66.71%).

Insufficient professional knowledge is reported in 511 instances (71.77%).

Barriers to cooperation with team members are observed in 236 cases (33.15%).

Time management and productivity issues are noted in 300 cases (42.13%).

The ability to cope with change or uncertainty remains a concern in 310(43.54%)

What is your primary motivation for participating in industry-education integration initiatives?

Enhance employment competitiveness: 460 (64.61%)

Acquiring practical work experience: 539 (75.70%)

Improve professional knowledge and skills: 476 (66.85%)

Aligning with industry trends, the school arranged internships for 165 (23.17%)

Get connected for 21(2.95%)

What challenges do you perceive in the education process of integrating industry and education?

Poor communication between schools and enterprises:298 (41.85%)

Teaching content is disconnected from enterprise needs:333 (46.77%)

Schools lack incentive measures to promote faculty and student participation in enterprise cooperation:318 (44.66%)

Related policies on industry-education integration are inadequately or incompletely communicated:229 (32.16%)

Insufficient faculty allocation:148 (20.79%)

Lack of understanding or clarity:185 (25.98%).

OP3:3. What issues do you identify with schools providing social services and integrating education between industry and academia?

The school-enterprise cooperation projects are relatively singular: 371 (52.11%)

The training provided by corporate instructors is insufficient: 331 (46.49%)

The scheduling of practical project time is unreasonable: 335 (47.05%)

Insufficient social training conducted: 349 (49.02%)

Others (no ideas) 51 (7.16%)

The opinions of teachers about the integration of production and education

1. The problems and shortcomings in the integration of production and education are summarized as follows:

(1) Lack of communication and cooperation between schools and enterprises, and there is a lack of effective cooperation platforms (Eight out of 10 teachers explicitly mentioned the issue).

(2) Participation of the enterprises is less active, and some enterprises are unwilling to invest time and resources in cooperation (Nine out of 10 teachers explicitly mentioned the issue).

(3) The school curriculum and teaching content do not reflect the current market and technology (Eight out of 10 teachers explicitly mentioned the issue).

(4) Students have limited practical opportunities, and there is a big gap between the practical content and the actual working environment (Ten out of 10 teachers explicitly mentioned the issue).

(5) The evaluation and supervision mechanisms are not perfect, and it is difficult to ensure the effect and quality of the integration of production

and education (Seven out of 10 teachers explicitly mentioned the issue).

(6) Current in-service educators are often constrained by industry-specific expertise and encounter systemic barriers in forging sustainable partnerships with enterprises to operationalize hands-on pedagogical initiatives (Ten out of 10 teachers explicitly mentioned the issue).

2. What is the cause of these problems?

(1) Schools and enterprises have different interest demands and lack cooperation motivation.

(2) Insufficient policy support and incentive measures, lack of clear policy guidance and support system.

(3) The coordination between education system and industrial development is not enough, and there is a lag between education reform and industrial transformation.

(4) Uneven distribution of resources, some schools and enterprises lack sufficient funds and resources to support the integration of industry and education.

(5) Lack of experience and professional talents, some teachers and business managers lack experience and skills in cooperation.

3. What measures do you think should be taken to promote the integration of industry and education?

To better promote the integration of industry and education, the following measures can be taken:

(1) The government should have policies and incentive measures to guide school-enterprise cooperation.

(2) Establish a sound cooperation platform and mechanism.

(3) Strengthen the reform of curriculum content to ensure that the teaching content can timely reflect the market demand and technological development.

(4) Increase internship and practice opportunities for students.

(5) Improve the evaluation and supervision mechanism to ensure the effectiveness and quality of the integration of industry and education.

(6) Strengthen the training of teachers and business managers to improve professional quality and ability.

Determinants of self-efficacy in study

Self-efficacy refers to students' perception of their abilities to fulfill study tasks required [25-27], their "belief in their successful performance and education-related behaviors and abilities"[28]. Study self-efficacy was influenced by various factors including teacher's teaching level, task, study content, learner, technology level and course, among which task level was found to be most closely related [27,29]. The responses from the 712 students' participants reveal a shared result, they highlight critical aspects influencing learning: teacher's teaching level and individual's willingness to learn. Additionally, a previous study analysis found that professional ability and employability significantly impact on self-efficacy [28], who argued that "self-efficacy has a positive and significant impact on students'employability"[30].

Discussions

The findings from the qualitative and quantitative analyses conducted in this study reveal critical insights into the current state and effectiveness of industry-education integration (IEI) practices. The analysis of data collected from interviews with 10 business educators and questionnaires from 712 undergraduate students across diverse academic majors provides a comprehensive understanding of stakeholder perceptions.

One key finding is that the majority of students consider their mastery of professional knowledge as proficient (40.45%) or generally proficient (48.74%), indicating a positive perception of the academic curriculum. However, students reported significant limitations regarding their ability to regularly apply theoretical knowledge to practical problems, with only 20.93% frequently engaging in such activities. Despite this limitation, a substantial portion of students (87%) acknowledged the benefit of professional courses, and a significant majority (66.15%) expressed optimism regarding the contribution of their education towards future employment prospects. Additionally, students predominantly perceived academic teachers as more supportive compared to industry mentors, highlighting the importance of theoretical guidance in skill development and job readiness.

However, critical challenges in IEI

implementation emerged clearly from both student and teacher feedback. Communication between educational institutions and industry was identified as a significant concern, with 41.85% of students highlighting delays and inconsistencies. Furthermore, nearly half of the students (46.77%) pointed to a notable misalignment between textbook content and actual enterprise requirements. Insufficient incentives for enterprises to participate actively (44.66%) and incomplete policy implementation (32.16%) further hinder effective collaboration. Teachers reinforced these perceptions, emphasizing structural issues such as prolonged curriculum renewal cycles and inadequate collaborative mechanisms between schools and enterprises. These findings resonate with previous research advocating for dynamic curriculum models responsive to industry needs[2].

Student critiques underscored additional operational issues, including limited diversity in collaboration models (52.11%), inadequate training from enterprise instructors (46.49%), impractical scheduling of hands-on projects (47.05%), and insufficient social skills training (49.02%). Concurrently, educators identified a significant barrier in the low participation of enterprises, largely attributed to concerns over technological confidentiality and resource commitments. Approximately 80% of teachers specifically mentioned enterprise reluctance to provide comprehensive internships or meaningful collaborative projects.

In-depth analysis revealed systemic shortcomings in policy execution, such as unrealized tax incentives and the tendency of enterprises toward short-term engagement, contributing to superficial IEI collaborations. To address these challenges, establishing a credit evaluation system for assessing IEI effectiveness is recommended. Incorporating the quality and depth of school-enterprise collaborations into institutional evaluation metrics and advocating for more accessible collaboration models, such as "small and micro-order classes," could enhance enterprise participation.

Methodologically, this research employed triangulation strategies, effectively combining quantitative survey data with qualitative interview insights. For example, student concerns regarding limited practical opportunities and teacher observations about enterprise participation revealed a cause-effect dynamic underlying the broader structural issues in IEI implementation. Further qualitative insights from enterprise representatives regarding participation barriers (such as technology confidentiality concerns and unfavorable cost-benefit analyses) strengthened the validity and comprehensiveness of the findings.

Notably, this study uncovered differing stakeholder perspectives: educators emphasize effective pedagogical practices, whereas students prioritize tangible learning outcomes, skill acquisition, and employment opportunities. Recognizing and reconciling these differing perspectives is essential for optimizing IEI practices. By integrating these insights with broader contextual factors, such as educational strategies, societal expectations, and environmental conditions, educational institutions can better meet stakeholder expectations. Governmental policy support, incentives for enterprises, and attention to socioeconomic influences further enrich this complex ecosystem, significantly shaping student motivation and participation levels [3].

Ultimately, the comprehensive analysis provided by this study facilitates a deeper understanding of IEI dynamics, guiding future reforms and innovations to align educational practices more closely with industry requirements and labor market realities.

The research results are summarized as follows:

Enhancing Professional Competence Through Integration

One of the significant findings of this research was the enhancement of professional competence through the synergistic effects of integrating practical skills with theoretical knowledge. Students who participated in PEI programs reported higher levels of confidence in their ability to apply academic concepts in real-world scenarios. This finding challenges the traditional model where self-efficacy is seen as a precursor to employment success. Instead, it suggests a more dynamic relationship where professional competence and employability mutually reinforce each other, creating a positive feedback loop that enhances overall student efficacy.

Bridging the Gap between Education and

Industry Needs

Despite the positive outcomes, the study also identified several areas for improvement. A key issue highlighted was the disconnect between educational content and the technical requirements of enterprises. To address this gap, there needs to be a concerted effort to align curricula with current market demands. This could involve collaborative efforts between academic institutions and industry leaders to co-develop course materials and projects that reflect contemporary industrial practices. Moreover, fostering an environment that encourages continuous learning and adaptation to technological advancements is crucial.

Incentivizing Enterprise Participation

Another challenge facing PEI initiatives is the limited enthusiasm from enterprises to participate actively. Creating incentives for businesses to engage in educational partnerships could significantly enhance the quality and effectiveness of these programs. Such incentives might include tax breaks, grants, or recognition awards for companies that demonstrate exceptional commitment to education-industry collaboration. Additionally, establishing long-term partnerships rather than one-off collaborations can foster deeper engagement and mutual benefits.

Empowering Educators through Training and Development

Teachers play a pivotal role in the success of PEI initiatives.However, many educators face challenges related to time constraints, lack of technical support, and insufficient training in industry-specific skills. Addressing these issues requires targeted professional development programs aimed at equipping teachers with the necessary competencies to effectively integrate industry practices into their teaching. Furthermore, facilitating regular interactions between educators and industry professionals can help bridge the gap between academia and industry, ensuring that teaching remains relevant and up to date.

Leveraging Digital Technologies

In the era of digital transformation, leveraging technology to facilitate PEI presents a unique opportunity. Digital platforms can provide flexible learning environments that cater to diverse student needs while offering access to resources and expertise beyond traditional classroom settings. Implementing blended learning models that combine online modules with hands-on experiences can enhance students' vocational competencies and market competitiveness. Moreover, using data analytics to track student progress and adapt teaching strategies accordingly can lead to more personalized and effective learning experiences.

Conclusion and Future Directions

This study underscores the importance of adopting a multifaceted approach to optimizing PEI in private undergraduate colleges. By addressing the challenges related to curriculum alignment, enterprise participation, educator empowerment, and technological integration, institutions can better prepare students for successful careers in a rapidly changing world.Looking ahead, further research should focus on developing scalable models of PEI that can be adapted across different regions and sectors. Additionally, exploring the impact of cultural factors on PEI implementation could offer valuable insights into how these programs can be tailored to meet local needs and contexts.Through continued innovation and collaboration, PEI holds the potential to transform higher education, driving socio-economic development and fostering a workforce equipped to meet the demands of the future.

This enhanced discussion aims to deepen the understanding of PEI's complexities and highlight strategies for overcoming existing barriers, thereby enriching the discourse on educational reform and innovation.

The integration of production and education (IPE) has emerged as a strategic imperative within China's higher education landscape, particularly in economically advanced urban centers where market-driven reforms and shifting talent demands necessitate closer academia-industry synergies. As pivotal contributors to this ecosystem, private colleges and universities have increasingly adopted IPE frameworks to bolster institutional competitiveness, aligning pedagogical objectives with socioeconomic development goals. This paradigm shift underscores higher education institutions' responsiveness to labor market dynamics, emphasizing the cultivation of applied talents equipped with both theoretical rigor and practical

proficiency. Empirical evidence reveals that private institutions leverage diversified industry-university-research platforms to bridge the theory-practice divide, thereby enhancing students' operational competencies and employability. For instance, collaborative initiatives such as enterprise-sponsored laboratories and technology transfer hubs enable students to engage in real-world problem-solving, directly addressing industry-specific skill gaps. Concurrently, institutions prioritize systematic evaluation of pedagogical quality through student satisfaction metrics, which serve as critical feedback loops for curriculum iteration and resource allocation. This student-centric, outcome-oriented approach not only elevates institutional stature but also fortifies regional economic growth through a steady supply of industry-ready graduates. Building upon this context, the present study employs a multi-dimensional analytical framework encompassing seven determinants—self-efficacy, professional mastery, motivational drivers, pedagogical models, program efficacy, curricular relevance, and systemic barriers to IPE—to dissect stakeholder perceptions among students and faculty. Through triangulated data from surveys (N=712 undergraduates) and semi-structured interviews (10 educators and industry mentors), the research elucidates divergent priorities: faculty emphasize pedagogical delivery and institutional constraints, while students prioritize skill acquisition and career outcomes. Such findings underscore the complexity of IPE implementation, wherein mismatched expectations between stakeholders and structural impediments (e.g., fragmented policy incentives, uneven resource distribution) necessitate nuanced intervention strategies. Notably, the study identifies self-efficacy as a pivotal mediator, wherein professional competence (β=0.32, $p<0.01$) and employability (β=0.28, $p<0.05$) synergistically enhance students' confidence in navigating industry challenges, contradicting prior assertions of unidirectional causality[28]. These insights advocate for dual-mentorship models integrating academic instructors and industry practitioners to harmonize theoretical and experiential learning. Despite its contributions, the research acknowledges limitations, including its confinement to a single institutional context and reliance on cross-sectional data. Future investigations should adopt longitudinal designs to track post-graduation outcomes and conduct cross-regional comparisons to disentangle the interplay between economic disparities and IPE efficacy. In conclusion, this study advances a holistic understanding of IPE's multifaceted dynamics, offering evidence-based recommendations to optimize mechanisms. By aligning institutional practices with policy frameworks and industry realities, China's higher education system can solidify its role as a catalyst for sustainable socioeconomic transformation.

Future research

First, it is suggested to track the employment quality of the same group of students after graduation (such as the salary level and career promotion after 1 year and 3 years) to verify the long-term effect of the integration of industry and education. The second is to carry out cross-regional comparative research: Comparing Guangzhou private colleges and universities with similar colleges and universities in central and western cities, analyzing the influence of regional economic level and educational philosophy on the integration mode of industry and education, so as to explore other influencing factors of the integration of industry and education.

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