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Integration of Education and Industry in China: Lessons from Germany Applied Universities

Zhaowen Yang, Furong Dong

School of Management, Guangzhou City University of Technology, Guangzhou, 510800, China

Abstract: ***This article delves into the significance of harmonizing education with industry requirements, with a focus on the German applied university system and its dual study model. It identifies challenges within the Chinese education-industry integration, such as inadequate cooperation and a skills gap, and contrasts these with the German model, where applied universities effectively bridge the gap between academic learning and industry demands. The methodology involves a systematic review of literature to extract insights into how Germany's dual study programs guarantee employment upon graduation and how China can adapt these strategies. A key finding is the importance of a collaborative approach between educational institutions and industries to cultivate a workforce that is equipped to meet the challenges of the modern labor market. The Duale Hochschule Baden-Wuerttemberg (DHBW) is highlighted as a case study, showcasing its successful integration of theoretical and practical education with industry partnerships. It is concluded with recommendations for China to enhance its education-industry integration, advocating for closer university-industry collaboration, decentralized governance, practical program design, flexible learning formats, and supportive policy frameworks. The paper underscores the potential for Chinese applied universities to improve talent cultivation by aligning with industry needs and promoting innovation and entrepreneurship, thereby increasing graduates' employability and contributing to societal development.***

Keywords: German applied university, Education-industry integration, University-industry collaboration, Dual study programs**.**

1. INTRODUCTION

In the ancient societies, few jobs were mechanized. Employers, as a result, selected employees based on their muscular abilities. Muscular and energetic individuals were preferred to weak people. The industrial revolution ushered in some changes in employee selection criteria. Skilled employees were preferred to unskilled individuals. This explains why there has been a noticeable increase in the value associated with formal education since the Industrial Revolution era (Becker et al., 2009). Courses offered in learning institutions were subsequently designed to suit specific roles in different companies. Over the years, such courses have been refined. The main reason for this was to ensure that competent employees were available in the job market upon completion of the courses. The advancement of technology and the adoption of innovations during the fourth industrial revolution further complicates the appropriateness of education gained in learning institutions (Darmaji et al., 2019; Robandi et al., 2019). For instance, the adoption of artificial intelligence is expected to give some companies an advantage over their competitors and to increase their operational efficiency. However, few tertiary institutions currently offer appropriate artificial intelligence education that suits the employers' demands.

The integration of education and industry benefits the two social systems in many ways. One of the benefits of post-secondary learning institutions is improved talent cultivation that meets the demands of the industries (Wei et al., 2020). Universities and colleges also develop applied undergraduate higher education as a result of education-industry integration. Industries experience heightened promotion of scientific and technological innovation, increased utilization of scientific research results, and improved economic returns from their products. Therefore, the successful integration of education and industry requires both sides to willingly cooperate. Applied universities are the basic learning institutions tasked with fostering applied talents that ultimately help enhance society's economic and social development. Effective integration of education and industry also requires government input to further encourage the exchange of knowledge and technology between the involved parties (Ankrah and Omar, 2015; Drobyshevskaya et al., 2020; Okeke-Uzodike and Anwana, 2020; Ma et al., 2022). In essence, government dictates the nature and scope of formal education offered in a given country.

Some scholars' research revolves around the existing situation and countermeasures for integrating education and industry in applied colleges and universities. According to a study by Gessler (2017), about 74.3% and 93% of companies lack the necessary coordination and cooperation respectively to promote education-industry integration.

Table 1: Table showing the lack of explicit collaboration in education-industry integration efforts by companies

		Company Size (employees) *			
		1 – 49	50 – 249	> 250	All **
Coordination	**Lack (total)**	**76.5 %**	**71.1 %**	**71.4 %**	**74.2 %**
	Does not exist	39.8 %	36.8 %	29.3 %	37.6 %
	Exists rather seldom	36.7 %	34.3 %	42.1 %	36.6 %
Cooperation	**Lack (total)**	**93.1 %**	**91.9 %**	**94.6 %**	**93 %**
	Does not exist	63.8 %	59.7 %	67.7 %	63.1 %
	Exists rather seldom	29.3 %	32.2 %	26.9 %	29.9 %
Co-construction	**Lack (total)**	**94.4 %**	**95.7 %**	**94.4 %**	**94.8 %**
	Does not exist	74.5 %	81.0 %	71.5 %	76.3 %
	Exists rather seldom	19.9 %	14.7 %	22.9 %	18.5 %

* = percentage based on valid data per category

** = percentage based on valid data in the sample

Source: Gessler, 2017

The existing literature reveals that there are some challenges affecting the integration of industry and education. Such challenges include a lack of effective cooperation mechanisms between education and industry, inadequate qualified teachers, as well a lack of practical training opportunities for learners (Liu, 2020; Huang, 2023). The existing literature proposes countermeasures to address such challenges. Some of the notable suggestions include the establishment of actual and active cooperation mechanisms between education and industry, the cultivation of qualified teachers, and the provision of more opportunities for the learners' practical training.

1.1 Overview of the Research Problem

Education and industry are two crucial social systems that shape human life. There are numerous efforts to harmonize these two social systems to further improve human life as well as both industry and education. In today's rapidly changing world, students need to develop essential skills such as intra-personal skills, innovative and critical thinking skills, and cross-cultural communication skills, to succeed in the workforce. Among these crucial skills is resilience, the ability to adapt and overcome challenges. While resilience is not an innate trait, it can be cultivated through various learning experiences. One effective approach is international mobility, which involves studying or gaining work experience abroad. This not only enhances the internationalization of institutions but also fosters resilience in students, ultimately boosting their employability (Krastina and Fuchs, 2020). Dual study programs represent another approach to skill development that incorporates both academic knowledge and practical workplace training. This approach has the potential to strengthen the connection between education and the economy, particularly in countries like the UK and the USA where student debt is a growing concern (Graf and Powell, 2022). These programs are often co-funded by employers, which can help to alleviate the financial burden on students and ensure that they are developing the skills that employers need.

However, there are underlying factors that hinder the realization of integrated industry and education. Such factors arise from the critical traits and social roles that assign different mechanism designs, orientations of values, and operation models to industry and education (Wei et al., 2020). Some of the common examples illustrating hindrances to integration include the inappropriateness of university development plans for regional economic development; the asynchronous nature of scientific research and design in higher learning institutions and technological innovations at the industry level (Li and Qi, 2017; Li, 2023; Wei et al., 2020); and the lack of desire to promote cooperation between industry and colleges by companies.

1.2 Objectives of the Study

The main objective of this study is to explore the integration of education and industry in Germany and come out with some insights to empower the Chinese education-industry integration process. The other objective is to find out the policies that foster the integration of education and industry. Lastly, the paper also seeks to identify the

impediments that discourage the integration of education and industry. This paper begins by providing a broad context of the education-industry integration topic. The paper then narrows down to case studies of some American applied universities. The following questions serve as the guideline for this research study.

- What policies are in place regarding the integration of education and industry in Germany?
- How do tertiary institutions facilitate the integration of education and industry in Germany?
- What are the difficulties of integrating education and industry in China?
- How can China replicate the successful integration of education and industry in education observed in Germany?

2. LITERATURE REVIEW

This study aims to give an insight into the integration of education and industry in Germany and determine some of the ways the Chinese education-industry integration process can be further enhanced. This section provides definitions for the main concepts discussed in this paper, their background, and their relevance to this study. To achieve this, this section entails an in-depth review of the existing literature concerning the concept of education-industry integration. Therefore, this section forms the basis of this paper.

2.1 Perspectives on Applied Universities

2.1.1 Traditional Role of Tertiary Learning Institutions

Tertiary learning institutions have traditionally played a significant role in addressing labor demands by offering learners with knowledge and skills that are important in succeeding in the workforce. These institutions have served as a bridge between employment and education, preparing graduates to enter the workplace as well as contributing to the economy. This has been achieved since tertiary learning institutions provide a broad range of professional and vocational programs that have been designed to equip learners with knowledge and specific skills needed for specific occupations (Lauder and Mayhew, 2020). These programs include internships, industry-specific certifications, and hands-on training. Besides this, education in tertiary institutions not only imparts technical skills, it also cultivates problem-solving, analytical, and critical thinking skills that are indispensable in today's dynamic as well as complex workplaces (Vinayan et al., 2020). With such skills, graduates have a higher chance of adapting to the ever-changing technologies, contributing innovative solutions, and navigating through complex problems.

In a rapidly changing workforce, individuals must have the ability to adapt and learn new skills. Traditionally, both in the Soviet and Western educational systems, tertiary learning institutions played a significant role in fostering lifelong learning by offering professional development opportunities, access to new knowledge and technologies, and continuing education programs (Kuraev, 2016). As a result, individuals can stay up-to-date with trends related to the industry and improve their employability all through their careers. The institutions also serve as hubs for innovation and research, creating new technologies and knowledge that promote economic growth as well as creating new employment opportunities (Osorno-Hinojosa et al., 2022). By teaming up with industries and carrying out thorough research, universities, and colleges aid in shaping the future of the workforce as well as preparing graduates for the demands of evolving fields (Hora, 2019).

2.1.2 Shift Towards Skilled and Innovative Labor

The main purpose of tertiary educational organizations has undergone major modifications as a result of many factors. Firstly, the rapid rate of technological changes in the world today dictates the nature of labor required. Innovations and technological developments are increasingly integrated into virtually all departments of organizations. As a result of this, such organizations seek to employ individuals who possess skills that support the efficient utilization of technological improvements (Kenney and Zysman, 2016). Similarly, traditional education systems are also forced to introduce curricula that support the acquisition of specific new labor skills. Secondly, some skills that were once deemed to be valuable are now regarded as obsolete (Hicks, 2017). Despite the prevalence of this trend, it is worth pointing out that some skills have increased in value over the years. The apparent shift in demand for some skills has a significant influence on the approach of tertiary educational institutions to developing labor skills.

Thirdly, the impact of globalization is evident in the labor market as well. There has been a substantial increase in competition for jobs in the past few decades (Rasiah et al., 2015). Globalization is one of the main factors behind

this trend. More people can easily secure jobs in regions that are far from their geographical location, provided they possess the required skills. On their part, post-secondary learning institutions continually modify their curricula to ensure graduates acquire the needed cross-cultural understanding and adapt better to different cultural setups (McRae and Ramji, 2017). Lastly, career progression and securing better-paying jobs often attract individuals with outstanding skills and abilities. Therefore, in addition to course-based labor skills, individuals strive to gain specific skills that can offer them an added advantage over potential competitors. This explains the shift from standardized curricula to personalized curricula that characterize the tertiary traditional education system and modern education models in that order (Sharma et al., 2017).

2.2 The Concept of "Education-Industry Integration"

2.2.1 Explanation and Theoretical Foundations

The concept of education-industry integration entails collective efforts by educational organizations and various industries to ensure the education and training offered meet the prevailing and expected labor market requirements. This is achieved by exchanging, resources, knowledge, and expertise between the two sets of stakeholders. In so doing, the graduates acquire skills and abilities that are desired by prospective employers. One of the main aims of integrating education and industry is to eliminate or lessen the gap between the skills acquired from educational institutions and the skills demanded by employers (Chavan and Bhujanga, 2015; Kulkarni et al., 2023). Effective collaboration between educational institutions and industries facilitates the timely identification of skill deficiencies in the existing workforce and the designing of appropriate curricula to address the issue (Nyemba et al., 2021; Kulkarni et al., 2023). In addition to this, the involvement of industries in educational activities promotes the adaptation of training programs to obtain graduates who possess emerging skills. In the end, such collaborations between industries and educational institutions help to bridge possible gaps in skills.

As discussed in the introduction section, it is evident that post-secondary education primarily prepares individuals for job placements. Such education is expected to offer graduates the required skillsets regardless of the prevailing labor market conditions. In relation to this, the second major aim of integrating education and industry is to promote the enhancement of relevance and practicality within the education systems (Gong and Wang, 2021). Involving industries makes the education offered in applied universities more appropriate and applicable as opposed to the traditional education systems. As a result of this, graduates gain insight into the applicability of their acquired skills and knowledge in prospective workplaces (Du et al., 2022).

The other notable aim of integrating education and industry is to promote innovation and entrepreneurship. Numerous companies have partnered with applied universities and reaped great benefits. In most cases, companies obtain new ideas, products, or services as a result of such collaborations (Kawasaki, 2016; Wirsich et al., 2016; Maier et al, 2023). The students are exposed to knowledgeable professionals who encourage them to be innovative and entrepreneurial. In a way, this helps the students to seamlessly adapt to the constantly changing requirements at the workplace. This is achieved by upholding the habit of never-ending learning that enhances continuous skill development and career progression.

Most students envision getting employed upon graduating. This ideal scenario is not always the case due to numerous reasons. However, the involvement of industries in educational systems facilitates a seamless transition from learning institutions to workplaces (John, 2017; Saba, 2022). Students increase their employability by taking part in internships, and apprenticeships, among other work-centred learning arrangements. Such learning programs allow the students to broaden their professional networks and gain practical skills that are invaluable in the workplace.

2.2.2 Importance for Individual Well-Being and Industries

There are significant positive impacts of the integration of education and industry in applied universities on employers, students, as well as society in general. The integration of education and industry can help learners develop competencies and skills that employers seek (Jackson and Wilton, 2016; Suarta et al., 2017). This can substantially enhance the learners' job prospects and employability upon graduation. Besides enhanced employability, learners are able to gain exposure to real-world industry challenges and practices through apprenticeships, internships, and other work-based studying opportunities (Cahill, 2016; Sobri et al., 2023; Zehr, 2016). As a result, education is made more relevant and practical to the learners' future careers. With the education-industry integration, learners also have the prospects to network with industry experts, build

professional portfolios, as well as enhance soft skills (Trajkovski et al., 2021; Bean and Dawkins, 2021). Additionally, learners are more engaged and motivated when seeing the direct link between education and future careers. This results in a greater sense of purpose and enhanced academic performance.

The integration of education and industry can help employers have access to a pool of graduates equipped with the knowledge and skills required to be productive from the first day at work (Jackson et al., 2017). Employers can also identify and interact with potential talent during apprenticeships and internships allowing them to build associations with excellent talents and securing their future employment. This enhances employee retention and reduces training costs (International Labour Organization, 2024). As shown in Appendix B, employers benefit more from experienced employees, particularly after apprenticeship. Figure 1 shows that approximately 83% of the recruitment costs incurred by companies in Germany cater for inducting the new employees (Federal Institute for Vocational Education and Training, 2020). Appendix A shows the amount saved by companies from their recruiting process (Wolter, 2020). Furthermore, employers can offer input into training programs and curriculum development, making sure graduates access the skills and competencies required to succeed in the workplace (Henrich, 2016; McMurray et al., 2016). The employers can also collaborate with universities on knowledge exchange initiatives and research projects, which can result in new product development and innovation.

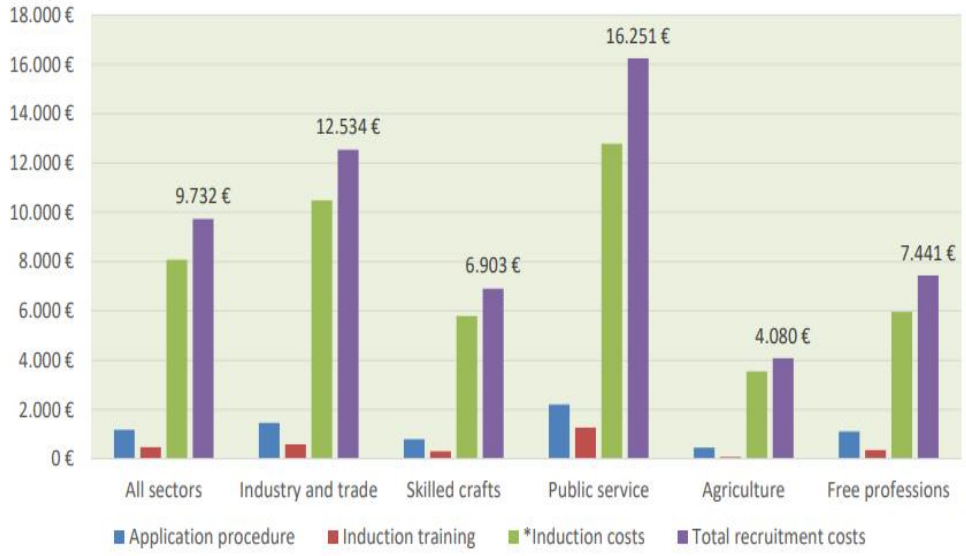

Figure 1: Bar graphs showing the cost of recruiting externally trained employees into different sectors

Source: Federal Institute for Vocational Education and Training, 2020.

2.3 Education-industry Integration in China

The concept of education integration is relatively new in China. As a result, the stakeholders in the education sector are yet to attain consensus regarding the most appropriate mode of undertaking education-industry integration in the country. Currently, there are several modes of education-industry integration (Wang and Zhang, 2023). The major tenets of the existing modes of education-industry integration tend to differ in some way. This explains why some applied universities have adopted more than one approach to education-industry integration.

A review of existing literature reveals six different approaches to education-industry integration in China. First, some vocational colleges in China embark on research development projects in partnership with companies. This approach is commonly referred to as the technical cooperation mode and it entails the company and vocational college sharing resources (Wang and Zhang, 2023). In the end, the joint operation between the two stakeholders results in the research and design of new products, procedures, or supplies. The second approach is called science and technology project mode and it is similar to the approach described above. The only difference is that this mode emphasizes coming up with solutions for technical problems that are encountered by the company during its production activities (Wang and Zhang, 2023). In other words, this mode does not aim to develop a new product, material, or process. Most small and medium enterprises prefer this mode due to their limited capital abilities and lack of adequate technology to solve technical issues.

The third approach is largely an adaptation of the dual study model that is synonymous with the German education system. The students under the modern apprenticeship mode of education-industry integration acquire both theoretical and practical skills as part of their education. Typically, the first three years are characterized by six months of theoretical knowledge at the vocational college followed by six months of apprenticeship in a company (Miu, 2015; Li and Liu, 2017). The students then learn about the main technology of the partnering company in their final year. Zhu and Li (2020) suggest that a joint undertaking between the applied universities and one or more external stakeholders is also another approach to education-industry integration. The researchers refer to it as vocational education group mode and each of the stakeholders has a role to play in the management of the group. The external stakeholders can either be companies, government institutes, research organizations, industry-related partnerships, or non-governmental organizations.

In some cases, vocational colleges collaborate with companies to set up training bases. Wang (2021) refers to this fifth approach as co-establishing a training base. Unlike in the case of vocational education groups, students in such training bases acquire specific technical skills that are in line with the collaborating company's workforce needs. The sixth mode entails the establishment of an additional academic faculty between the vocational college and the partnering company (Wang and Zhang, 2023). This approach encourages the companies to actively take part in training the students throughout their time at the learning institution.

3. METHODOLOGY

The purpose of this study is to review the integration of education and industry in Germany and suggest applicable ways through which China can enhance education-industry integration. This section describes the methodology utilized to complete this study. The section is organized into three subsections titled 'searching and selecting studies', 'analysis and synthesis', and 'descriptive data'. Under the first subsection, there is a description of how the utilized studies were located and selected. The second subsection provides an analysis and synthesis of the existing literature considered in this study. The last section is a brief overview of the number of studies found, selected, and analyzed during this study.

3.1 Research Methodology

There are four research questions that act as guidelines for this study. A systemic review of the literature was the preferred research methodology to answer the research questions. Denyer and Tranfield (2009) define systematic review methodology as an approach that entails locating the present literature, selecting and assessing the results, analyzing and synthesizing data, and reporting the findings in a manner that encourages making rational conclusions about the known and unknown. This study took into consideration the main principles of systematic review. In doing so, the study can be replicated and biases arising from the subjective evaluation of various researchers were greatly minimized (Tranfield et al., 2003; Adams et al., 2017). The systematic review process comprised of three steps namely finding the existing literature, selecting and evaluating studies, and analyzing and synthesizing the findings. Rojon et al. (2021) point out that effective synthesizing is an important element of any systematic review because it helps to shed light on the major findings and their relevance to research.

3.2 Locating and Selecting Studies

The researcher began the study by searching a vast database of academic business journals in November 2023. This database, EBSCO Business Source Premier, contained over 14,900 peer-reviewed journals published between 2000 and 2023. The researcher chose this specific time frame due to the growing emphasis on collaboration between universities and industries in recent years.

The information was gathered solely from academic articles written in English that had undergone a rigorous review process by other experts in the field. Search terms applied were "China", "Chinese education", "applied for universities", "universities of applied sciences" "industry-education integration", "university-industry collaboration", "industry-academia partnership", "vocational education", "work-integrated learning", "Germany", and "German higher education." The researcher also used the boolean operator AND to obtain more focused materials. These included "Germany" AND "applied universities" AND "industry-education integration", "China" AND "industry-education integration", "China" AND "applied universities", and "China" AND "Germany" AND "applied universities." These terms strike a balance between comprehensiveness and specificity, ensuring they capture the most relevant articles while filtering out irrelevant ones.

The researcher set four filters to evaluate studies, excluding those that did not meet the criteria. The first criterion was accessibility whereby only accessible documents were included. Secondly, studies that did not involve both industry and universities or education were excluded. Non-scientific materials such as book reviews were also excluded. Additionally, the studies which did not directly address the integration of education and industry were excluded. Despite these filters, the researcher aimed for a broad range of studies to gain a comprehensive understanding of integration between education and industry, even if they were not directly addressed.

3.3 Analysis and Synthesis

To analyze the articles, the researcher critically organized the information found from the search summarizing key points such as processing techniques, material properties, potential limitations, and applications. The researcher also went ahead to identify trends and commonalities. The researcher continuously cross-checked the results, and when in doubt, the researcher consulted a reviewer who provided their perspectives and a discussion was held to obtain a final decision. Essential data including reference details, research goals, methodology, type of collaboration, country and university setting, findings, limitations, and integration between education and industry, was collected. Based on the analysis, the researcher had a comprehensible picture of the materials researched. This included strengths and weaknesses, as well as possible applications. Furthermore, links between different concepts or materials were explored. This involved comparing and contrasting properties, identifying opportunities for merging techniques or materials, and associating synthesis approaches to resulting structures.

3.4 Descriptive Data

The study identified 69 articles matching the specific criteria. Most of these articles were qualitative, with a few being literature reviews. Few articles were particularly case studies. This would have been because the search terms were too specific, thus, excluding related case studies that utilize different terminologies.

4. RESULTS

The intention of this study is to provide insight into the integration of education and industry in Germany and consequently point out the different lessons that can enhance the Chinese education-industry integration process. This section describes the dual-system study model that is popular in Germany. The Duale Hochschule Baden-Wuerttemberg (DHBW) university is described hereunder as a case study to put the concept of education-industry integration into perspective.

4.1 Integrating Education and Industry in Germany

Baker (2014) argues that Germany has played a pivotal role in shaping the modern research university, with its institutions serving as benchmarks for excellence across diverse fields and industries. As the world's third-largest producer of scientific output, Germany has made significant contributions to both theoretical and applied advancements (Van Zyl, 2014). Despite facing periods of decline and resurgence throughout the 20th century, Germany has consistently demonstrated its prowess in both scientific research and practical applications (Dusdal et al., 2020).

In Germany, a growing trend in higher education is the integration of university studies with either vocational training or part-time work experience in companies. These so-called dual study programs typically guarantee graduates' employment upon completion. While this approach provides hands-on, practical education, the curriculum and teaching methods remain largely unchanged from decades past and require modernization (Krastina and Fuchs, 2020). For universities, the major benefit of these programs is forging strong relationships with local businesses, while also attracting and educating highly motivated, qualified students who have been vetted by the companies. These close ties with companies are becoming increasingly crucial for universities, as they can serve as sources of additional funding (European Commission, 2023). Simultaneously, students immediately apply the theoretical knowledge gained at university in the workplace, setting them apart from their peers and enhancing their future employability (Krastina and Fuchs, 2020).

Germany's well-established apprenticeship and continuing professional development systems, which are closely aligned with research and industry, are considered the cornerstone of its economic success. Most companies are unwilling to collaborate with applied universities if their expected benefits are lower than the projected costs they would incur when training the apprentices. According to a study by Lerman (2014), companies from Germany

spend approximately €46,600 only to realize €24,000 in benefits. Such a scenario. Nonetheless, cooperating companies actually benefit from taking part in the dual study models of education as shown in Figure 2.

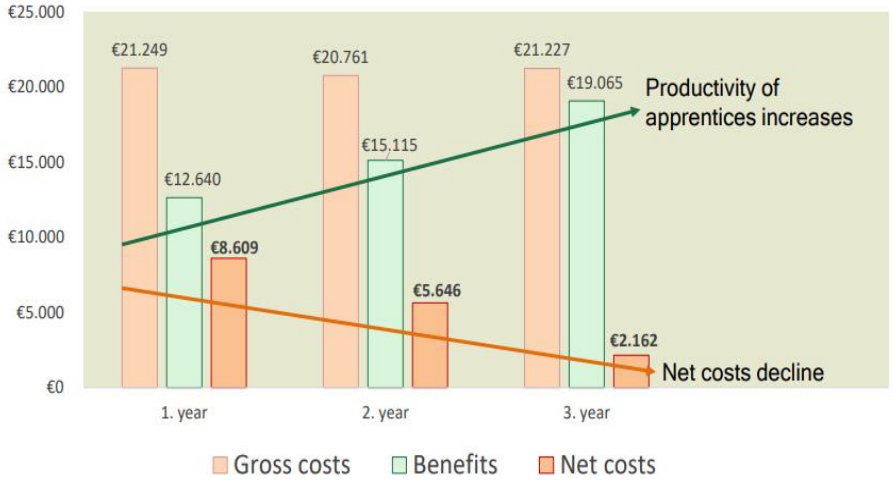

Figure 2: Relationship between the cost incurred and the accrued benefits for cooperating companies

Source: Federal Institute for Vocational Education and Training, 2020.

From the figure above, it is evident that the cooperating companies incur less costs on training the apprentices in each additional study year. At the same time, the positive contribution of the trainee increases with each additional study year they spend in the company.

4.2 Germany's Work-integrated Education

Education-industry integration is closely associated with the dual-system study model that promotes efforts from both universities and companies. Germany is credited with the introduction and popularization of the dual-system study model. The model varies in expected completion duration and arrangement over the years. The model can be adopted in either of its three major forms. The first form entails combining a normal academic study program with elementary vocational training (Parlow and Röchter, 2016). This form requires students to start by completing training in a company. At the end of the apprenticeship, the students are awarded either a certificate from the Chamber of Industry and Commerce (IHK) or the Chamber of Crafts (HWK) (Zuchowski et al., 2021). The students then proceed to a university of applied sciences where they earn a Bachelor's degree upon graduation.

The second arrangement is a direct combination of theoretical education at applied universities and practical lessons in relevant companies. The repetitive study pattern of students enrolled in this model entails attending theoretical lessons at an applied university for a given duration before going in for practical lessons at a given company for a similar duration (Parlow and Röchter, 2016; Gerloff and Reinhard, 2019). The last form of dual-system study applies to qualified and experienced employees who choose to partake in educational programs concurrently with their professions. In this case, the individuals' professional experiences are integrated into their study programs (Parlow and Röchter, 2016). The theoretical studies in this model are often offered when the individual is free or can find time to study.

4.3 Case Study: Duale Hochschule Baden-Wuerttemberg

The Duale Hochschule Baden-Wuerttemberg (DHBW) is arguably the earliest tertiary institution to adopt the dual-system study model in Germany (Zhang and Chen, 2022; DHBW, 2024). The institution boasts a population of approximately 34,000 students, more than 9,000 collaborating companies, and over 210,000 graduates (DHBW, 2024). This makes it one of the largest universities in Germany. Collaborations between the university and renowned companies such as Robert Bosch and Daimler-Benz can be traced back four decades ago. The standout traits of the dual-system study in DHBW were a consequence of the university allowing certain companies to train students as equal partners (Gerloff and Reinhard, 2019). In addition to this, work experience was a major incorporation into all study programs in the institution (DHBW, 2024).

According to DHBW (2024), the institution is made up of three schools namely the School of Engineering,

Business School, and the School of Social Work Studies. Besides the Master's degree program that was introduced later, the university majorly offers Bachelor's degree programs which typically take three years to complete. The dual-system study model for the degree programs is characterized by alternating 3-month segments whereby students are taught theoretical concepts at the university and on-the-job training from collaborating companies (DHBW, 2024). The benefits extended to the students during the on-the-job training period at the companies include monthly remuneration, employment contracts lasting the duration they are at the company, and insurance schemes similar to those of employees in the respective companies (Gerloff and Reinhard, 2019). The students are regularly required to reflect on their work experiences while in the university and to directly apply the acquired theoretical knowledge in the companies.

The dual-system study model is basically a public-private partnership when viewed from a financial and organizational standpoint. DHBW is a public tertiary institution that offers theoretical education. The university's expenses are catered for by the federal state of Baden-Wuerttemberg through tax revenues. German nationals and students from the European Union member countries do not pay tuition fees at this university. The collaborating companies and organizations are private entities. The role of such private stakeholders is to cover the costs of training the students as well as provide them with monthly salaries when undertaking the on-the-job training (Gerloff and Reinhard, 2019). DHBW has empowered the partnering companies by allowing them to receive student applications, administer tests, and carry out interviews to select students (Osieja, 2017; Gerloff and Reinhard, 2019). The successful applicant then signs contracts with the companies and is registered with DHBW. As a result of this, the university admits highly motivated students which significantly lowers the number of dropouts. The companies also benefit in that the large number of graduates increases the number of qualified prospective employees. Reinhard et al. (2016) point out that the employability of DHBW graduates as well as job security is close to 90% which is a testament to the success of the dual-system model in the university.

The decentralized structure of DHBW University also enhances the effectiveness of the dual study model. There are twelve locations throughout the federal state that serve as either campuses or branch campuses for the university (DHBW, 2024). Such decentralization enables the university to support business sectors in many regions thereby attracting more partnering organizations, particularly the small and medium-sized enterprises (Gerloff and Reinhard, 2019). As a result of this, students are also able to study in locations that are closer to their families or preferred employers. The educational institution also achieves its aim of teaching classes with fewer students which promotes student-centered study methods like presentations. The closeness to partner companies allows the university to regularly incorporate feedback from the companies into its dual study curricula. On the other hand, the companies benefit by cooperating with the university on certain projects and they lower the cost of hiring new talents (Gerloff and Reinhard, 2019).

5. DISCUSSION AND RECOMMENDATIONS

The objective of this study is to look at the integration of education and industry in Germany and determine ways in which the Chinese education-industry integration process can be enhanced. This section serves the purpose of discussing the main points noted from the case study and literature review sections. In addition to this, the section also provides recommendations that are relevant to the Chinese education-industry integration process.

5.1 Lessons from Germany's Work-integrated Education

There are several lessons that China can learn from the dual vocational training system in Germany as they make efforts to integrate education and industry in applied universities. First, Germany possesses a strong collaboration between industry partners, vocational schools, and universities (Wahjono and Kristianto, 2022). While upholding educational regulations, universities and institutions should work closely with businesses to adapt their curriculum and training programs to keep pace with evolving industry needs. Such a close collaboration can significantly improve the quality of graduates for the workforce thereby increasing employer satisfaction with their skillsets (Aliu and Aigbavboa, 2020). China can imitate this approach by developing closer ties between applied universities and industry through joint research projects and internships, and co-designing of the curricula. One successful example of such collaboration is Hezhou University's initiative. By partnering with various enterprises, they established seven "industrial colleges" where resources are shared by both parties (Wei et al., 2020). These "two colleges in one" models utilize the same faculty for the university's existing programs and the newly established industry-focused ones. This collaborative approach has demonstrably improved the quality of graduates as they receive an education that is directly relevant to industry demands.

Another lesson is on governance and funding. Germany has a decentralized educational system that empowers universities to tailor curricula to meet evolving needs (Dedering et al., 2015). As a result, students easily adapt to regional industry needs. China should consider decentralizing its system to facilitate regional responsiveness and innovation to local demands. Applied universities and colleges should align their programs with the needs of the leading industries in their region. They should regularly review and adapt their contributions to ensure they meet the current demands of the job market (Mustafa, 2019). By doing this, these institutions can create unique and valuable programs that cater to the specific needs of their regional economy and community. Applied universities in Germany are funded by different entities such as government, private donations, and industry (DC dVET, 2016; European Union, 2023). China should also consider diversifying funding streams and encouraging private-sector investment in education.

Program delivery and design have been a key element in Germany's applied universities. Germany prioritizes practicality in their vocational education. Applied universities in Germany carefully design courses based on their real-world application and how well they integrate with a student's chosen career path (DHBW, 2024). This ensures graduates have strong practical and hands-on skills. In contrast, China's vocational institutions often prioritize theoretical knowledge, neglecting practical application (Guo, 2022). Guo (2022) further notes that instructors in Chinese vocational colleges either possess industrial experience or are conversant with industrial methods. This negates the situation in Germany where on-the-job training teachers are active employees in different companies. Chinese applied universities should consider deepening their hands-on learning through labs, real-world projects, and workshops (Wen and Wang, 2023). This can help equip their graduates with relevant skills required by industries and mould them to be more employable.

There are flexible learning options in German universities including blended learning formats and part-time programs (Müller, 2019). Such options allow individuals who are working to pursue further education and accommodate diverse student needs. If China implements this, applied education can be more accessible thus encouraging more individuals to enrol. Besides this, just as Germany focuses on entrepreneurship, Chinese applied universities can foster the same spirit by integrating entrepreneurial training into applied programs as well as encouraging innovation hubs within universities.

Lastly, the policy frameworks that inform the design and adoption of education-integration curricula in China require amendments. Applied universities in Germany generally agree on the design and execution of dual study models because of effective government policies and frameworks. The same cannot be said about China despite the huge strides made in the past decade. Several factors hinder the successful rollout of education integration in China. Some of the most notable factors include the unsuitability of university development plans for regional economic development, the incompatible nature of scientific research and design in vocational colleges and technological innovations at the company level (Li, 2023; Wei et al., 2020), and the lack of efforts by companies to promote cooperation between industry and vocational colleges (Zhang, 2019). The pie chart in Figure 3 outlines some of the major reasons why companies shy away from cooperating with applied universities in training students.

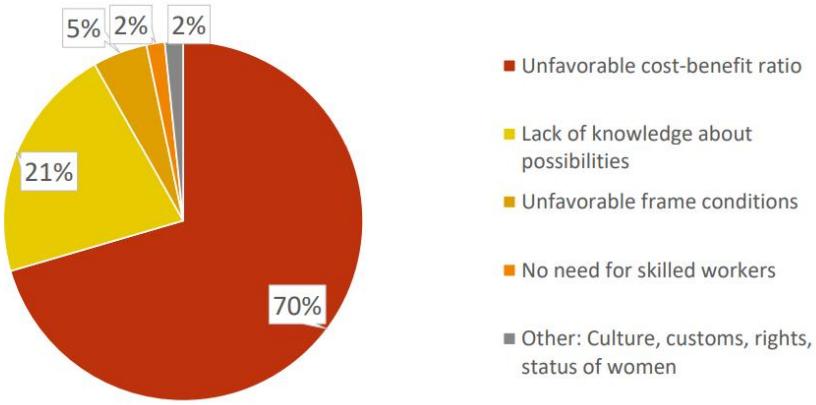

Figure 3: Notable reasons discouraging companies from collaborating with applied universities to conduct dual study programs

Source: Jaik, 2022.

Based on their fiscal studies, most companies project that they are bound to spend more on training the apprentices whilst getting little value for their money. This is the greatest reason hindering companies from participating in education-industry integration efforts.

6. CONCLUSION

There is a consensus that industry-education integration is important for the cultivation of high-quality professional degree postgraduates. The existing literature on the concept of education-industry integration identifies several factors that hinder the process. Some of the notable factors include failure to attain mutual benefit and win-win cooperation between the academic institutions and companies, increased demand for multi-dimensional talent cultivation, and a lack of quality assurance systems to enhance the education-industry integration efforts (Ji and Dai, 2023). To promote the integration of industry and education in the training of professional degree postgraduates in China, there is a need for specific efforts and strategies that include developing joint training programs, promoting the exchange of students and faculty, building education-industry training bases, and establishing education-industry advisory committees.

Industry-education integration is a collaborative effort between universities and industry enterprises to enhance the quality of talent training. It is a teaching model that incorporates scientific research, social services, and talent training. Industry-education integration is a mutually beneficial partnership between campus and off-campus entities such as government agencies, enterprises, and research institutions. From the DHBW case study, it is apparent that education-industry integration addresses the practical teaching challenges faced by colleges and universities, enhances students' practical skills, and aligns education with societal needs. On the other hand, industry-education integration streamlines the channels for comprehensive "collaborative education," enhances the "San Quan" education model of universities, and provides employers with greater opportunities to participate in the education process (Li, 2023). Together, the talent supply and demand sides collaborate to create "talent products," ensuring that the talents cultivated are well-equipped to meet societal needs, significantly improving their professional quality and employability.

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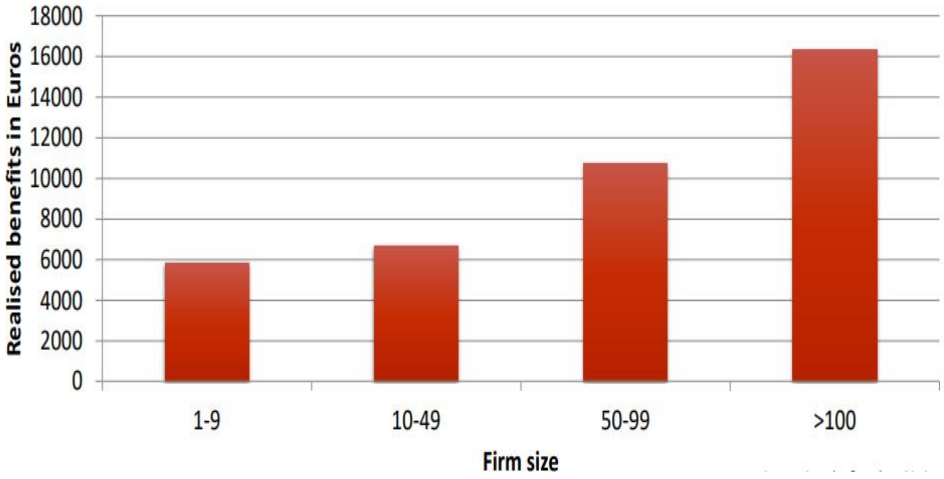
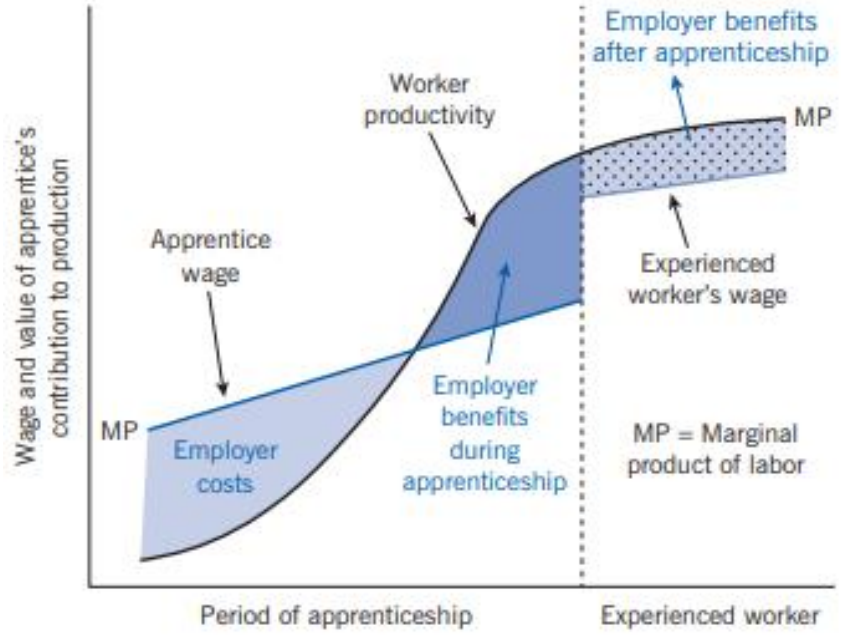
APPENDICES

Appendix A: Saved employment and induction expenses per trained student



Source: Wolter, 2020

Appendix B: Apprenticeship training model



Source: Lerman, 2014