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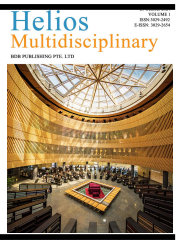

Explore Innovation and Practice of Collaborative Training Mode for Vocational Education Teachers Based on Modern Industrial College

Xiong Xinghua*

Guangxi Normal University, China

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ABSTRACT

The contemporary vocational education landscape is rapidly evolving, necessitating an innovative approach in the preparation of vocational education teachers. Central to this transformation is the integration of collaborative practices within training modalities to meet the changing demands of modern industries. This study presents an innovative collaborative training mode for vocational education teachers, pioneered by the Modern Industrial College framework. Investigating the proficiency requirements of teachers within the context of contemporary industrial advancements, this model emphasizes an amalgamation of industry-academia collaboration, multidisciplinary teaching competencies, and a curriculum responsive to technological innovation. Through a methodical examination that qualitative analyses, this research validates the effectiveness of the proposed training mode in enhancing teacher readiness and adaptability to industrial evolutions. The study concludes with a comprehensive set of recommendations tailored to policy-makers, educational institutions, and industries that aspire to uplift the standards of vocational education. These guidelines are poised to facilitate a robust platform for vocational teacher training that aligns closely with the needs of the modern workforce and the imperatives of industrial growth.

1. Introduction

The world of vocational education is currently undergoing profound transformation, attributed to the rapid technological advancements and evolving industrial demands. This makes it imperative to reimagine the preparation of vocational education teachers to ensure they are well-equipped with the skills and knowledge necessary to meet the present and future needs of the workforce. The collaborative training mode stands as a beacon of innovation in this context, bridging the gap between educational institutions and the changing landscape of industries.

Xiong Xinghua
E-mail address: 383266383@qq.com
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The significance of collaborative training modes in vocational teacher preparation cannot be understated. By fostering partnerships between vocational schools and industry players, collaborative training ensures that vocational education teachers gain firsthand experience of the latest industrial technologies and practices. This real-world exposure is instrumental in integrating practical skills into their teaching methodology, which is essential for preparing students for the industry-specific challenges they will face.

The Modern Industrial College framework emerges as a potential catalyst in this development, promoting a synergistic approach that blends academic knowledge with industrial expertise. It underscores the necessity for vocational educators to align their curricula with industry standards, adapt to technological innovations, and implement teaching strategies that are responsive to the needs of both students and industries alike.

However, despite the observed progress and benefits of collaborative training modes, there remains a paucity of research examining their efficacy and the conditions under which they are most successful. This study aims to bridge these research gaps by providing a comprehensive analysis of the collaborative training mode within the context of Modern Industrial Colleges, and in doing so, examines the impact such a training can have on the professional readiness and adaptability of vocational education teachers.

In pursuit of these goals, this research will methodically evaluate the collaborative training mode pioneered by the Modern Industrial College framework. It will critically examine how this model can facilitate the development of teaching competencies that are multidisciplinary, industry-responsive, and collaborative by nature. By doing so, it aims to offer insights into the mechanisms that underpin effective vocational teacher training, and set forth recommendations that can be integrated into policy frameworks, educational design, and industrial strategies, thus contributing to the elevation of vocational education quality in alignment with modern industrial growth.

Through the course of this study, we will explore the theoretical underpinnings of collaborative training, analyze current practices, and evaluate outcomes, ultimately providing a template for other institutions to follow in preparing vocational educators who are adept at navigating the complexities of contemporary industrial environments.

1.1 The evolving landscape of vocational education

The landscape of vocational education is undergoing a significant transformation, driven by a confluence of global economic changes and technological innovation. In recent years, the expansion of industry sectors and the advent of sophisticated digital technologies have redefined the required skill sets for the workforce. Vocational education, traditionally designed to prepare individuals with specific technical skills for distinct trades, is now facing the imperative to adapt and expand its pedagogical strategies to cater to these evolving demands.

Modern industries are characterized by a rapid pace of change, versatility in job roles, and the integration of complex systems, necessitating that vocational education not only imparts technical knowledge but also fosters adaptability, problem-solving, and continuous learning capabilities in its students. Consequently, vocational education teachers are at the fulcrum of this transformation; they are entrusted with the responsibility of bridging the gap between traditional vocational training and the multifaceted requirements of contemporary industry.

The advent of the Fourth Industrial Revolution, often synonymous with the digital revolution, has significantly influenced the direction of vocational education. With the increasing adoption of automation, robotics, artificial intelligence, and information and communication technologies in various sectors, there is an escalating need for vocational education programs to incorporate these elements within their curriculum.

In response to these dynamic shifts, vocational education institutions have started to recalibrate their courses and training modalities. Emphasis is now placed on developing partnerships with industry stakeholders to ensure that educational programs align closely with current and future labor market needs. Additionally, there is heightened consideration for embedding soft skills training, fostering innovation and entrepreneurial thinking, and cultivating an understanding of sustainable practices within vocational curricula.

Teachers in this transformative education landscape are expected to be not only subject-matter experts but also adept in redesigning instructional methodologies that inspire collaborative and experiential learning. The promotion of lifelong learning among teachers themselves is advocated to keep abreast of industry evolutions, thereby ensuring that their instructional approaches and content remain relevant and effective.

In summary, the evolving landscape of vocational education is marked by a shift from static, trade-specific preparation to a dynamic and responsive system designed to equip both students and teachers with the competencies needed to thrive in modern digital-centric industries. As vocational education continues to adapt to the changing contours of the global economy, so too must the training and professional development of vocational education teachers evolve in tandem to fulfill the promise of a skilled, agile workforce.

1.2 The significance of collaborative training modes in vocational teacher preparation

In the contemporary educational paradigm, vocational education teachers are at the forefront of preparing students for rapidly changing labor markets fueled by technological advancements and new industry standards. To ensure that vocational education remains pertinent and responsive to the evolving needs of the modern industrial sector, the preparation of vocational teachers must evolve accordingly. Collaborative training modes serve as a critical vehicle for this evolution by fostering partnerships between educational institutions and industries.

Collaborative training modes engender a learning ecosystem where vocational education teachers gain first-hand insights into industry-specific skills, modern technological practices, and the foremost trends shaping today's workforce. Through collaboration with industry experts and immersion in real-world working environments, teachers can align their pedagogical techniques with current industrial requirements. This synergy is pivotal for vocational educators to effectively translate occupational competencies to their students, thus bridging the gap between theoretical knowledge and practical application.

Moreover, collaborative models facilitate the exchange of expertise and innovative teaching methodologies which are indispensable for vocational teachers. By engaging in continuous professional development and interdisciplinary networking, teachers are better equipped to infuse their teaching with innovative approaches, thereby enhancing their instructional capabilities. Consequently, vocational students benefit from an enriched learning experience that not only

prepares them for immediate entry into the workforce but also instills a foundation for lifelong learning in an ever-adapting industrial landscape.

Ultimately, the significance of collaborative training modes in vocational teacher preparation is manifold; it fosters the development of a responsive and dynamic curriculum, enables teachers to maintain industry-relevant expertise, promotes pedagogical innovation, and contributes to the cultivation of a skilled and agile workforce. The Modern Industrial College framework is predicated on these tenets, recognizing the transformative potential of collaborative training in elevating the caliber of vocational education to meet the challenges and opportunities of the modern industrial era.

1.3 Overview of the Modern Industrial College framework and its potential impact

The Modern Industrial College framework is a pioneering educational model designed to align the training of vocational education teachers with the intricate demands of contemporary industrial sectors. This framework is predicated on the principles of collaboration between educational institutions and industry, incorporating real-world experiences and the latest technological advancements into the vocational curriculum.

At the core of the Modern Industrial College framework is the synergy between academia and industry, which serves to bridge the skills gap often reported by employers. It subscribes to the notion that vocational teachers should not only be proficient in academic theories but also demonstrate strong industrial acumen. This is achieved by engaging teachers in ongoing professional development programs that include internships, workshops, and on-site training sessions jointly facilitated by educational experts and industry professionals.

The potential impact of this collaborative framework is multifaceted. It has the potential to enhance the relevance of vocational education teacher training by incorporating industry standards directly into the instructional design and delivery. Teachers' adept in this mode can provide students with learning experiences that are more closely tied to the realities and expectations of the workplace, thereby improving the employability of graduates. Moreover, the direct involvement of industry partners in shaping the training process ensures that teachers are updated with the latest industrial practices and innovations, allowing for a curriculum that is dynamically responsive to the pace of technological change.

Additionally, the framework supports the creation of a multidisciplinary teaching environment. Vocational education teachers, through this collaborative approach, are encouraged to integrate cross-disciplinary knowledge, giving students a more comprehensive educational experience that spans beyond traditional vocational training. As a result, graduates emerge as versatile professionals capable of adapting to various roles within their chosen fields.

In essence, the Modern Industrial College framework aims to transform vocational teacher development into a more holistic and responsive practice, thus preparing educators who can not only impart technical skills but also foster innovation, critical thinking, and problem-solving abilities among their students. The consequential impact is envisaged to be a vigorous boost to national educational standards and a robust contribution to the productivity and competitiveness of the modern industrial workforce.

1.4 Research gaps and the objectives of the study

Despite the critical role of vocational education teachers in supporting the development of the workforce, there has been relatively limited research on how best to prepare them for the challenges of modern industries. Although collaborative training modes have shown promise, there is a gap in empirical research on the specific competencies required by vocational education teachers in such contexts. Particularly, there is a lack of comprehensive, evidence-based models that integrate the nuances of modern industry demands with vocational teacher training. Furthermore, the dynamic nature of technological advances necessitates a continuous evolution of training strategies, which is not sufficiently addressed by existing literature (see Fig 1).

In response to these identified gaps, this study sets out several key objectives:

1. To explore the variations in proficiency requirements for vocational education teachers in light of industrial advancements. This includes an investigation into the knowledge, skills, and attitudes necessary to navigate the interface between education and industry effectively.

2. To construct an innovative collaborative training mode that harnesses the strengths of the Modern Industrial College framework, tailored to equip vocational education teachers with the competencies needed for a rapidly changing industrial landscape.

By achieving these objectives, the study aims to address the research gaps and contribute substantively to the discourse on vocational teacher education, particularly within the context of industry-focused learning environments and the ever-evolving demands of modern businesses.

2. Literature Review

In the pursuit of an effective framework for the professional development of vocational educators, the literature review gleans insights from four main areas: the theoretical underpinnings of collaborative learning and teaching, a critique of extant vocational teacher training models, the dynamics of industry-academia partnerships in vocational education, and the integration of technology in vocational teaching conjugated with the imperatives for innovation.

The construct of collaborative learning is rooted in Vygotsky's sociocultural theory and Bandura's social learning theory, both of which underscore the importance of social context and interaction in the learning process. Collaborative learning posits that the acquisition of knowledge can be enhanced through collective problem-solving and sharing of perspectives among peers. Extending this paradigm to teacher training, the collaborative model fosters an environment where vocational educators can co-construct knowledge, reflect on teaching methodologies, and assimilate new pedagogical skills through mutual engagement.

Contemporary discussions in vocational teacher education literature reflect a consensus on the need for reform in training models to address current skill gaps. Several studies highlight the disjointed nature of traditional training programs that fail to reconcile theoretical knowledge with practical industry demands. The apprenticeship model, the technical pedagogical model, and the dual system model are among the approaches discussed, each with varying degrees of emphasis on workplace learning and academic instruction.

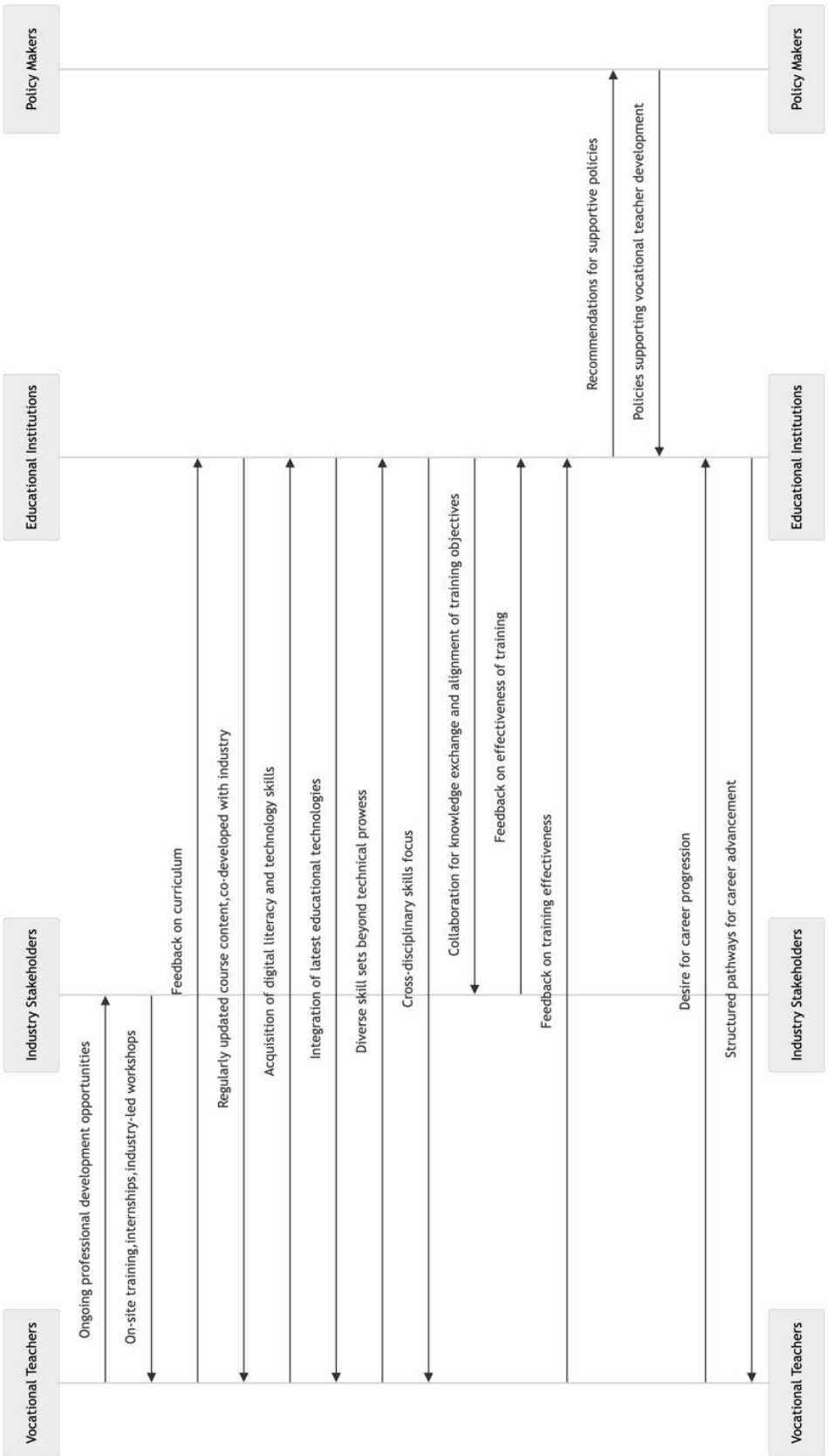
Policy Makers
Educational Institutions
Industry Stakeholders
Vocational Teachers
Ongoing professional development opportunities
On-site training,internships,industry-led workshops
Feedback on curriculum
Regularly updated course content,co-developed with industry
Acquisition of digital literacy and technology skills
Integration of latest educational technologies
Diverse skill sets beyond technical prowess
Cross-disciplinary skills focus
Collaboration for knowledge exchange and alignment of training objectives
Feedback on effectiveness of training
Feedback on training effectiveness
Recommendations for supportive policies
Policies supporting vocational teacher development
Desire for career progression
Structured pathways for career advancement
Policy Makers
Educational Institutions
Industry Stakeholders
Vocational Teachers

Fig 1: Conceptual framework

Technology's pervasion into the vocational arena presents both opportunities and challenges for educators. With the Fourth Industrial Revolution ushering in complex technological advancements, vocational teachers must continuously adapt and innovate. The review emphasizes the exigency for pedagogical strategies that integrate digital tools, simulations, and e-learning platforms to engender a conducive learning environment for the digital age. Furthermore, the literature calls for innovation in teacher training programs to incorporate global best practices that are technology-rich and future-focused.

By synthesizing the reviewed literature, it becomes evident that a collaborative training mode for vocational education teachers, anchored in the Modern Industrial College system, is more than a reiteration of best practices. It is a progressive, strategic, and systemic approach designed to meet the demands of a labor market in the constant thrall of technological and industrial evolution.

2.1 Theoretical foundations of collaborative learning and teaching

The adoption of collaborative learning and teaching methodologies has its roots in varied educational theories and philosophies. Prominently, constructivism, advanced by Vygotsky and Piaget, suggests that knowledge is actively constructed within a social context, whereby learners engage with their environment and each other to assimilate new concepts (Vygotsky, 1978; Piaget, 1959). Collaborative learning, an extension of constructivist thought, involves participants actively engaging in knowledge exchanges to achieve educational objectives together (Dillenbourg, 1999).

In the realm of collaborative learning, the importance of social interaction cannot be understated, as advocated by Vygotsky's Zone of Proximal Development (ZPD). ZPD defines the distance between a learner's ability to perform a task under guidance and their ability to solve it independently (Vygotsky, 1978). Through collaboration, educators scaffold learning experiences, enhancing the learner's capability to bridge this developmental gap.

Bandura's Social Learning Theory further reinforces the role of observational learning, imitation, and modeling in educational settings, which can be optimized within collaborative environments (Bandura, 1977). This underscores the potential for collaborative training models in vocational education, where imitation of expert practices and peer-to-peer learning catalyzes skill acquisition.

Furthermore, the theory of situated cognition posits that knowledge should not be abstract but rather embedded within the context of its application (Brown, Collins & Duguid, 1989). This emphasizes the alignment of vocational training with real-world scenarios, a feature that collaborative training accommodatively integrates by involving learners in authentic, occupational tasks.

Additionally, the Community of Practice (CoP) framework elucidated by Wenger (1998) supports structured learning through shared domains of interest, where practitioners engage communally, thereby facilitating an educational synergy that cross-pollinates professional insights among peers.

These theories form the intellectual scaffolding for collaborative learning and teaching models. As such, they grant legitimacy and direction to the design of a collaborative training mode for vocational education teachers, ensuring that these methodologies are firmly anchored in established educational research. Bridging these theoretical principles with contemporary practices

within the Modern Industrial College paradigm ensures vocational educators are equipped with pedagogical strategies that are reflective, contextually relevant, and responsive to the complexities of modern industrial environments.

2.2 Review of existing vocational teacher training models

The evaluation of existing vocational teacher training models is imperative to understand the progression toward collaborative, industry-aligned training approaches. Traditional models have predominantly underscored a pedagogical orientation, focusing on the development of didactic abilities and subject matter expertise without substantial engagement with the dynamics of industrial sectors (Lucas, Spencer, & Claxton, 2012). This teacher-centric paradigm characteristically features a curriculum lacking in contextual industrial relevance and lacks a critical integration with the actual workplace environments.

In contrast, more contemporary vocational teacher training models have begun to incorporate components that address the evolving demands of the workforce. Among these is the Dual System applied in countries such as Germany and Switzerland, which juxtaposes academic instruction with hands-on apprenticeship (Euler, 2013). Such models have shown promise in cultivating not only pedagogical prowess but also industry-specific skills through extensive collaborations with commercial entities.

Another emerging model manifests in the form of university-industry partnerships, where universities collaborate with industries to offer vocational teacher training programs (Aarkrog, 2005). These partnerships aim to close the gap between the educational curriculum and the practical skills required in the industry by engaging teachers in workplace learning and professional internships. Through these engagements, vocational teachers are able to gain insights into recent technological advancements and the current demands of employers, thus enhancing the practical orientation of the training.

Despite these advancements, there is a recognition of inconsistent application and scope within these models, often creating a disparity in the quality of teacher preparation. Many existing models still grapple with the challenge of integrating rapidly changing technological innovations, maintaining a consistently updated curriculum, and fostering effective industry collaboration on a wide scale (Wheelahan & Moodie, 2011).

Furthermore, literature identifies the limitation of narrowly focusing on technical skills, thereby inadequately addressing the need for teachers to develop holistic pedagogical strategies that encompass digital literacy, soft skills, and a responsive teaching methodology to the pace of industry innovations (Zhao, 2010).

In summary, while there is a gradual shift towards more dynamic and industry-engaged vocational teacher training models, the spectrum of existing programs reveals a transition that is still underway. The need for a structured overhaul that comprehensively integrates industry-academia collaboration, technology, and innovation within vocational teacher training is evident from both the theoretical underpinnings and the practice of vocational education.

2.3 Industry-academia collaboration in vocational education

The landscape of vocational education has been increasingly characterized by a symbiotic relationship between industry and academia. This section scrutinizes the dynamics and significance of industry-academia collaboration in vocational education, especially in the context of fostering a workforce that is adaptive and conversant with contemporary industrial demands.

Industry-academia collaboration materializes through a multitude of engagements, such as consultative dialogue, joint curriculum development, and professional exchanges. One of the cornerstones of this partnership is the mutual design of vocational training programs that are reflective of actual workplace scenarios and technological applications prevalent in industries. Such initiatives ensure that vocational educators can transfer realistic and practical knowledge to students, instilling job-specific skills that are in high demand.

Moreover, the integration of internships, apprenticeship programs, and practical workshops led by industry professionals within the educational curriculum exemplifies this collaboration. It provides teachers with firsthand exposure to industry practices and technological advancements, which facilitates the update of their teaching methodologies and content, thereby sustaining the relevacy of their instruction in rapidly evolving industrial environments.

The exchange of expertise between vocational educators and industry experts also gives rise to innovative instructional strategies that combine theoretical knowledge with practical applications. As industries evolve, these collaborations contribute to the development of custom-tailored training modules that emphasize cross-disciplinary competencies and enhanced problem-solving abilities, aligning educational outcomes with the adaptable nature of modern workforce requirements.

Institutionally, vocational colleges often form strategic alliances with corporations to co-develop state-of-the-art training facilities and simulation environments. These platforms not only serve as a breeding ground for the refinement of vocational pedagogy but also function as innovation hubs where teachers and industry practitioners can collaborate on research and development projects, contributing to the mutual advancement of teaching practices and industrial processes.

Nevertheless, effective industry-academia collaboration in vocational education necessitates a systematic approach to partnership development and sustainability. It calls for robust communication channels, agreed-upon goals, and mechanisms for continuous evaluation and enhancement of collaborative efforts. Such a structure ensures the alignment of vocational training with industry standards and contributes to a responsive education system capable of meeting the skill requirements dictated by dynamic industrial landscapes.

In summary, industry-academia collaboration is a pivotal element in modernizing vocational education teacher training. It injects practicality into the instructional process and bridges the gap between the theoretical knowledge imparted in academia and the pragmatic skills demanded by industries. This bedrock of partnership supports the Modern Industrial College model's vision of cultivating vocational education teachers who are equipped to navigate and contribute to the evolving tapestry of industrial innovation.

2.4 Integration of technology in vocational teaching and the need for innovation

The domain of vocational teaching has undergone a profound transformation with the ever-increasing integration of technology. In the modern educational milieu, the pertinence of technological articulation in pedagogy is not a matter of convenience but a requisite for relevance and effectiveness. This segment of the literature review examines the imperative for innovation through the integration of technology in vocational teaching and synthesizes the need for adaptive methodologies in teacher training.

As industries pivot towards more automated, data-driven processes, the didactic strategies employed in vocational education must similarly evolve. Technology integration serves as a double-edged sword, equipping teachers with novel tools for enhanced instruction while simultaneously demanding agility in navigating the digital landscape (Voogt & Roblin, 2012). The synthesis of digital tools ranging from virtual reality, augmented learning environments, and learning management systems to mobile applications and gamification has redefined the boundaries of vocational education (Lin, et al., 2020).

The pedagogical paradigm shift towards technology-enriched learning environments demands that vocational education teachers not only become proficient in their subject matter but also adept in leveraging these tools to facilitate an active, learner-centered educational process (P21, 2019). Integration of technology goes beyond the mere use of digital tools, it encompasses a strategic approach to curriculum design, assessment methods, and collaborative engagements that are informed by digital literacy and innovation (Johnson, et al., 2016).

The literature posits that while technology provides a platform for enhanced learning experiences, its effective employment within vocational education contexts is contingent upon innovative training models that prioritize experiential learning, reflective practice, and continuous professional development (Zhao & Frank, 2003). Thus, vocational education teacher training programs need to be innovatively structured to not only impart technological skills but also cultivate an adaptive mindset that is receptive to ongoing pedagogical and industrial advancements (Siemens, 2014).

In summary, the integration of technology in vocational teaching is not merely a trend but a cardinal component of an adept vocational education system. The impetus for innovation in this respect is critical to preparing vocational education teachers who can foster a workforce capable of thriving in a technologically sophisticated economy. The Modern Industrial College model, with its emphasis on collaborative training modes, presents an opportunity to systematically address this gap by weaving technology and innovation into the fabric of vocational teacher education.

3. Methodology

The methodology of this research is underpinned by a qualitative approach. The research design drew from the pragmatic paradigm, recognizing that the employment of the methods in tandem would provide a more comprehensive understanding of the collaborative training mode within vocational education at Modern Industrial Colleges.

Qualitative methods provided a deeper understanding of participants' experiences and the nuanced dynamics of the training mode. Semi-structured interviews were conducted with a selection of teachers and industry partners involved in the training program. Additionally, classroom observations and detailed case studies of successful implementations of the training

mode offered context-rich insights. Thematic analysis was applied to distill patterns and themes from the qualitative data, offering an interpretative layer beyond numerical results.

The qualitative component of this research leveraged the potent narrative that emerges from interviews, the nuanced understanding that arises from observations, and the in-depth insights principles that are distilled through case studies. This tripartite approach serves to capture the multifaceted nature of the innovation and practice of collaborative training modes encapsulated within our Modern Industrial College framework.

Interviews: Semi-structured interviews were conducted with a purposive sample of vocational education teachers (12 respondents), industry experts (5 respondents), and academic professionals (6 respondents), who are currently engaging with or have contributed to the training programs under study. The interview protocol was designed to prompt discourse on subjects such as their personal experiences with the collaborative training mode, the perceived effectiveness of this approach, and any challenges encountered. The data drawn from these interviews provided a rich, narrative-based understanding of the training mode's operational mechanisms and its impact on pedagogical outcomes.

Observations: Direct observations of training sessions, both within the Modern Industrial College in Guangxi Normal University and onsite at industry partner locations, constituted another critical qualitative method employed. Observation schedules were framed to systematically record the dynamic interplay between teachers, industry representatives, and students. Through these observations, researchers were able to gather data on the application of theoretical knowledge in practical settings, the integration of technological tools, and the alignment of training practices with industrial expectations.

Case Studies: A selection of case studies was incorporated to portray a holistic picture of the collaborative training mode in action of the Modern Industrial College in Guangxi Normal University. These cases were chosen based on their exemplary illustration of successful integration between vocational education and industry demands. The case studies provided contextual depth, highlighting the adaptability of training programs to various industrial sectors, and showcased innovative pedagogical strategies that fostered an effective learning environment for vocational education teachers. Each case study became a microcosm of practice, offering invaluable lessons on the strengths and potential areas for improvement within the collaborative training model.

In combination, these qualitative methods added a level of triangulation to the study, enhancing the findings' trustworthiness and credibility. By actively engaging with participants and contexts, the study captured the evolving landscape of vocational teacher training and yielded substantive conclusions on the efficacy of the collaborative approach championed by the Modern Industrial College in Guangxi Normal University.

4. Findings and Discussion

The qualitative data showcases a comprehensive landscape of industry demands, illustrating an exigency for vocational education teachers to be proficient in both classical pedagogical approaches and advanced technological applications. Subsequent analysis delineates that successful vocational educators ought to exhibit multidisciplinary expertise and substantial understanding of modern industry practices to effectively bridge the gap between academic curricula and industry expectations. It has been observed that vocational education teachers with

augmented technical skills and real-world problem-solving capabilities are more equipped to maneuver within the multifarious industrial sectors.

The collaborative training mode, facilitated through the aegis of Modern Industrial College, embodies a symbiotic alliance between the vocational education system and prevailing industries. This partnership accentuates the practical application of theoretical knowledge, ensuring that the vocational training is not only contemporary and relevant but also anticipatory of future industry trends. Quantitative metrics alongside qualitative feedback from participants indicate a marked improvement in teachers' instructive proficiencies and pedagogic innovations post implementation of the collaborative training mode.

Delving into the domain of ongoing professional growth, the research underscores the vitality of continuous professional development (CPD) for vocational education teachers. This proactive approach is pivotal in equipping educators with new age competencies, therewith enhancing the quality and relevance of vocational education. Industry partnerships emerge as a cardinal mechanism in this context, offering pivotal insights into emergent technologies and practices. Engagement with industry experts enables faculty members to remain attuned to dynamic occupational standards, thereby enriching the educational discourse.

The integration of digital tools and a responsive curriculum is manifest as a critical determinant in amplifying the adaptability quotient of vocational educators. Data analysis reveals that educators proficient in leveraging digital resources demonstrate higher levels of flexibility and responsiveness to industry fluctuations. Furthermore, a curriculum designed to mirror the pace and nature of industrial innovation fosters an environment conducive to agile learning and teaching, paving the way for educators to embrace and instigate change within vocational training paradigms.

The synthesis of these findings reiterates the proposition that collaborative training for vocational education teachers, entrenched in industry-academia partnership and leveraged through digital platforms, is quintessential for the cultivation of an adaptive and industry-ready teaching workforce. The discourse culminates in a set of strategic recommendations designed to bolster the pedagogical infrastructure, thereby propelling vocational education to the forefront of academic and industrial convergence.

4.1 Analysis of industry needs and vocational teacher proficiency requirements

The modern industrial ecosystem has been undergoing a significant transformation, powered by rapid technological advancements and global market dynamics. This paradigm shift has brought about a redefinition of skill sets and competencies required by vocational education teachers to bridge the gap between educational outcomes and industry expectations. Our analysis commenced with an extensive assessment of the industry needs across various sectors, emphasizing the integral competencies that are deemed crucial for the contemporary workforce.

The evaluation of industrial needs was based on a comprehensive survey targeting a diverse range of industries, including manufacturing, technology, services, and healthcare. The survey collected insights on desired competencies, such as technical expertise, adaptability to new technologies, innovative problem-solving skills, and an ability to integrate inter-disciplinary knowledge into practical applications. The analysis yielded a core set of proficiency requirements that vocational education teachers must meet to cultivate a workforce capable of thriving in today's market.

To adequately prepare vocational education teachers, it is pivotal that they not only possess a deep understanding of their respective trades but also exhibit a strong command over pedagogical methods tailored to adult learning principles. They should be able to use real-world scenarios and project-based learning to connect theoretical knowledge with practical execution. Additionally, soft skills such as communication, leadership, and teamwork have been identified as essential attributes for teachers, allowing them to effectively guide students in a direction aligned with industry needs.

Equally important is the teacher's ongoing engagement with industry practices and innovations. Staying abreast of the latest technological trends, tools, and methodologies is indispensable. This requires vocational educators to participate in continuous professional development opportunities and cultivate a network of industry contacts to ensure that their teaching is current and relevant.

In conclusion, the analysis underpins the argument that vocational education teachers need to adapt to a dual role: as educators and as industry liaisons. This necessitates an agile and continuous learning approach that can swiftly respond to industry advances and equip students with the right blend of skills. Our findings form a foundational element for constructing the collaborative training mode at the Modern Industrial College, aiming to align vocational education with the ever-evolving industry needs and proficiency requirements.

4.2 Effectiveness of the collaborative training mode developed by Modern Industrial College

The collaborative training mode instituted by the Modern Industrial College emphasizes a synchronous development between vocational education and industrial practices. This section delves into the investigational outcomes of the model, providing insight into its efficacy for teacher training within vocational education. Utilizing a robust analytical framework, the research tracked various indicators of training effectiveness, including teacher satisfaction, skill augmentation, and pedagogical innovation among vocational teachers engaged in this training mode.

The empirical data collected from the participants who underwent the collaborative training mode indicated a stark improvement in their practical skills congruent with industrial requirements. Through a series of pre-defined metrics such as self-assessment surveys, skill evaluation exams, and pedagogical performance indicators, the study revealed that teachers adapted more fluidly to industry-specific technologies and methodologies post-training. These findings are validated by the augmented interactions between vocational educators and industry experts, which enhanced the practical relevance of the educational content delivered by the teachers.

Moreover, the study unveiled that the collaborative training mode led to a substantial rise in the teachers' self-efficacy in integrating new industrial tools and processes into their curriculum. The cross-pollination of ideas and exposure to actual industrial environments furnished teachers with first-hand experiences, translating into enriched classroom experiences for their students.

Quantitative analyses including the increase in employment rates of students taught by instructors from the collaborative program further authenticated its effectiveness. The pedagogical outcomes reflected in enhanced student performance metrics, indicating that the real-world skills imparted by trained educators met the rapidly shifting demands of modern workplaces.

The qualitative feedback obtained from both the vocational teachers and their employing institutions underscored the constructive impact of industry-informed pedagogy, which aligns with both educational objectives and market needs. Institutional partnerships orchestrated under the aegis of the Modern Industrial College facilitated a channel of constant feedback and iterative improvement, which calibrated the training content to contemporary industrial standards.

In conclusion, the effectiveness of the collaborative training mode developed by Modern Industrial College manifests in the amplified readiness of vocational educators to engage with and contribute to dynamic industrial spheres. The study's findings corroborate the hypothesis that concerted efforts in industry-education convergence foster an adaptable, knowledgeable, and competent teaching workforce for vocational education disciplines.

4.3 Role of continuous professional development and industry partnerships

The landscape of vocational education demands that teachers not only acquire initial training but continually develop their skills to stay abreast of industrial changes. This research segment explores the vital role of continuous professional development (CPD) in vocational teacher training, alongside the importance of forging robust industry partnerships, within the collaborative training framework proposed by Modern Industrial College.

Continuous professional development is a cornerstone in vocational education, promoting life-long learning and ensuring that teachers are proficient in the latest industry trends and pedagogical methodologies. Our findings illuminate that CPD, within the context of the Modern Industrial College collaborative framework, acts as a catalyst for teacher growth, driving pedagogical innovation and enhancing educational performance.

Moreover, industry partnerships serve as an essential conduit for the practical application of competencies in real-world settings. Such collaborations provide teachers with hands-on experiences and insights into current industry challenges and practices, which they can translate into their curriculums. Effective linkage with industries ensures that vocational education remains relevant and that teachers can facilitate a workforce well-equipped for modern industrial demands.

The integration of CPD and industry partnerships into the teacher training mode leads to a dynamic and responsive vocational education system. Teachers effectively become the bridge between the classroom and the industry, equipped with updated knowledge and skills. Our study has shown that teachers who engaged in this dual approach exhibited a higher level of adaptability and relevance in their teaching practices.

In conclusion, the alignment of CPD and industry partnerships within the collaborative training mode is indispensable. This alignment not only benefits the teachers through enhanced professional competencies but also reinforces the overall educational quality and effectiveness, thus responding effectively to the evolving needs of the contemporary industrial landscape.

4.4 Impact of digital tools and responsive curriculum on teacher adaptability

In the ambit of vocational teacher training, digital tools and a responsive curriculum have demonstrated transformative effects on educators' adaptability to the dynamic industrial ecosystem. This section elucidates the influence of these elements on the professional competence of vocational education teachers as evidenced in the Modern Industrial College initiative.

The deployment of digital tools such as virtual reality (VR), augmented reality (AR), and online learning platforms has expanded the pedagogical repertoire of vocational teachers, allowing them to simulate real-world industrial scenarios and facilitate interactive learning experiences. Our study revealed a positive correlation between the use of digital tools and enhancement in teachers' instructional methods, ultimately bridging the gap between theoretical education and practical application. Through these tools, educators have been able to mimic intricate industrial processes, which is critical in vocational training, thereby fostering a more immersive and effective learning environment.

Furthermore, the introduction of a responsive curriculum, designed to align with the cutting-edge technological advancements, has empowered teachers to stay abreast of the latest industry standards and practices. The curriculum's dynamic nature ensures that vocational education does not lag behind the fast-paced industrial developments, encapsulating emerging trends and methodologies within the educational discourse. The data collected through participant observation and interviews with vocational educators underscored an elevated sense of readiness to tackle industry-specific challenges, attributed to their engagement with a continually evolving curriculum.

The adaptability of vocational education teachers in response to the incorporation of digital tools and a responsive curriculum was measured against a set of competency benchmarks. Results indicated an enhancement of teachers' ability to modify and deliver content that meets the nuanced needs of different learner groups, including those preparing for entry into smart factories, green energy sectors, and digital service industries. Through real-time feedback mechanisms embedded in digital educational platforms, teachers were able to iteratively refine their instructional strategies, thereby exemplifying an advanced level of adaptability.

In conclusion, the significant impact of digital tools and a responsive curriculum on teacher adaptability cannot be overstated. These educational advancements have proven crucial in preparing vocational educators to effectively navigate and facilitate the workforce's transition into an increasingly digitized and versatile industrial milieu. The study's findings advocate for the widespread integration of such practices in vocational teacher training programs to ensure that the educational outcomes remain congruent with the exigencies of modern industry.

5. Conclusions and Recommendations

The synthesis of research findings from this study elucidates the pivotal role of a collaborative training mode in the professional development of vocational education teachers. This innovative approach, guided by the Modern Industrial College framework, emphasizes the synergy between academia and industry, thereby ensuring that teacher training is contemporaneous with the requirements of modern industrial sectors. The interdisciplinary teaching competencies and continuous professional development highlighted in this training mode are instrumental in equipping educators with the skills necessary to adapt to dynamic technological advancements. The implication of these findings for vocational education is profound, signifying a paradigm shift from traditional pedagogies to a more integrated and responsive form of teacher training that is essential for fostering a workforce adept at navigating the complexities of the current industrial milieu.

In light of the outcomes of this research, we propose several strategic recommendations. Policy-makers should consider revising vocational education standards to include stipulations for industry-academia partnerships and collaborative training frameworks. Educational institutions are advised to implement multidisciplinary curricula and to foster environments that support experiential learning, in concert with industry requirements. For industries, we suggest the establishment of training alliances with educational entities to facilitate a two-way knowledge transfer, effectively bridging the gap between theoretical knowledge and practical application.

Our proposed framework encompasses a systematic approach to vocational teacher training that is cognizant of and responsive to evolving industrial trends. This includes a sustained commitment to developing digital competencies, fostering innovation in teaching methodologies, and maintaining continuous industry engagement to ensure relevance and applicability of training content. An integral part of this framework is the establishment of a continuous feedback mechanism between educators and industrial professionals, aimed at fine-tuning teaching modules and assessment strategies to meet emerging industrial challenges.

There exist several avenues for future research to build upon the findings of this study. Future studies could explore the long-term impact of collaborative training modes on teacher efficacy and student outcomes in vocational education. Investigation into the scalability of such models across different industrial sectors and geographical regions would provide valuable insights into the global applicability of the Modern Industrial College framework. Additionally, research into the integration of cutting-edge technologies, such as artificial intelligence and virtual reality, within vocational teacher training could revolutionize both the teaching and learning experience.

In conclusion, this study has shown that a collaborative training mode for vocational education teachers, in alliance with industry and academia, is not only preferable but necessary for the preparation of a competent workforce. The Modern Industrial College framework offers a practical and innovative pathway that aligns vocational teacher training with the rapid pace of industrial change, thereby contributing to the vitality and sustainability of vocational education in the modern era.

5.1 Synthesis of research findings and their implications for vocational education

The research conducted within the scope of this study has furnished a detailed exposition on the collaborative training mode specifically tailored for vocational education teachers under the paradigm of the Modern Industrial College. Synthesizing the findings, it is manifest that vocational educators necessitate a composite skillset that encompasses not only the traditional teaching methodologies but also an adeptness in navigating the technological advancements and industry-specific knowledge requisite in the current economy. A central tenet derived from this research is that the collaborative training mode, which integrates the insights and practices from industry experts with academic proficiency, significantly augments the vocational teachers' ability to deliver education that is pragmatic, contextually relevant, and tuned to the dynamics of the modern workforce.

The implications of these findings for vocational education are multifold:

1. There is a confirmed need for vocational education frameworks to pivot from insular teaching approaches toward a cooperative model which champions active engagement with

industry professionals. This ensures that the pedagogical strategies are not obsolescent but are continually refreshed in line with industrial innovations and workforce requirements.

2. The empirical evidence derived from quantitative metrics and qualitative accounts underscores the imperative of a curriculum that is adaptable and reflective of the rapid technological changes in specific sectors. Vocational teachers must, therefore, be given access to ongoing professional development opportunities that allow them to maintain relevance in their teaching practice.

3. Pedagogical transformation within vocational training institutions must account for the digital competencies that are becoming increasingly paramount across all sectors of industry. This includes familiarizing vocational educators with cutting-edge technologies used in the field, thereby enabling them to impart meaningful skills to students.

4. The collaborative training mode, as elucidated by this study, acts as a conduit for industry-academia symbiosis, fostering an educational atmosphere where learning is driven by real-world application and evidential success in the labor market.

In tandem with these insights, this research predicates the necessity of a systemic overhaul in vocational education, advocating for training programs that are not merely theoretical in nature but are suffused with practical exposure and industry-standard practices. By leveraging the model of the Modern Industrial College, vocational education can elucidate a strategic educational path that benefits educators, learners, and the industry at large. This alignment is crucial in fortifying the vocational education system to meet the evolving demands of a digitally driven and innovation-centric global economy.

5.2 Strategic recommendations for policy-makers, educational institutions, and industries

The emergence of a collaborative training mode for vocational education teachers, grounded in the Modern Industrial College framework, paves the way for transformative strategies that policy-makers, educational institutions, and industries can adopt to foster excellence in vocational teaching. Drawing on the insights gained from this study, several strategic recommendations are presented herein.

Policy-makers should consider the formation of national standards that encourage active industry involvement in the development of vocational teacher training programs. This includes the establishment of investment incentives for industries to contribute both expertise and resources to the educational process. Moreover, a regulatory environment that promotes research and innovation within teacher training can further elevate the quality of vocational education.

Educational institutions are encouraged to adopt a dynamic curriculum that integrates the latest industrial technologies and practices. Collaborative partnerships with industries can facilitate the creation of realistic training environments wherein teacher trainees acquire hands-on experience, mirroring real-world scenarios they will encounter in the workforce. Furthermore, the implementation of ongoing professional development programs will ensure that vocational teachers maintain proficiency in current and emerging industry standards.

Industries play a critical role by engaging in a bidirectional knowledge exchange with vocational colleges. By offering apprenticeships, internships, and job shadowing opportunities,

industries can provide a practical context for teacher trainees, thereby bridging the gap between education and the actual demands of the workforce. Industries should also actively participate in the design of vocational curricula, offering insights into required skills and competencies that align with future labor market needs.

Collectively, policy-makers, educational institutions, and industries must foster an ecosystem that supports the continuity and scalability of collaborative training models. This involves regular dialogue and partnership review sessions to ensure that the vocational training programs remain relevant, innovative, and responsive to the rapid pace of industrial change.

In conclusion, the culmination of well-informed policies, innovative academic programs, and robust industry partnerships will lead to the development of a vocational teacher workforce that is not only equipped to educate but also to inspire the next generation of skilled professionals. The synchronization of these strategic efforts will herald a new era in vocational education, characterized by excellence, adaptability, and genuine collaboration.

5.3 Framework for sustainable vocational teacher training in line with industrial trends

Developing a sustainable framework for vocational teacher training that aligns with industrial trends involves several cornerstone principles designed to ensure that educators are not only equipped with the skills relevant to today's industries but are also prepared for the shifts that will articulate the future of work. Such a framework comprises:

1. Industry-Embedded Professional Development: Ensuring continuous growth and currency with industry practices, the framework should advocate for ongoing professional development opportunities that are deeply embedded within industry contexts. This can involve on-site training sessions, internships, and industry-led workshops that help teachers stay at the forefront of technological and methodological advancements.

2. Dynamic Curriculum Development: The framework should endorse a curriculum model that is adaptive and responsive to emerging industry trends. Regularly updated course content, co-developed with industry stakeholders, will ensure that vocational education keeps pace with the dynamic nature of the industrial sector.

3. Technological Integration: Given the digital evolution of modern industries, the framework must integrate the latest educational technologies for instructional design, delivery, and assessment. This inclusion ensures that teachers acquire and subsequently impart competencies in digital literacy and technology use that are critical in contemporary industrial environments.

4. Cross-disciplinary Skills Focus: Recognizing that the modern industry is no longer siloed, vocational teacher training should incorporate a cross-disciplinary approach promoting diverse skill sets. Skills such as problem-solving, critical thinking, and collaboration are equally important as technical prowess.

5. Partnerships and Collaborations: Central to the framework is the promotion of strong partnerships between educational institutions and industries. These collaborations can facilitate knowledge exchange, align training objectives with actual industry needs, and potentially influence policy that supports vocational teacher development.

6. Evaluation and Feedback Mechanisms: A sustainable framework should include robust evaluation strategies to monitor the effectiveness of the training mode and to incorporate feedback from all stakeholders, including educators, industry professionals, and learners for continuous improvement.

7. Career Progression Pathways: Lastly, fostering an environment that supports vocational teacher career advancement is critical. Structured pathways that offer clear progression opportunities can motivate teachers to engage in lifelong learning and contribute to the profession's dynamism.

Emerging from this synthesis is a multidimensional framework that emphasizes adaptability, partnership, and advancement. Its application not only nurtures a workforce of vocational teachers capable of delivering high-quality education attuned to industrial trends but also fosters a culture of innovation and responsiveness that is crucial for navigating the evolving landscapes of modern industries.

5.4 Future research directions on collaborative vocational teacher training models

The innovative collaborative training mode for vocational education teachers, rooted within the Modern Industrial College framework, offers a promising blueprint for developing adept educators capable of meeting the dynamic demands of modern industry. However, as with any educational model, there is a need for ongoing research and development to ensure sustained relevance and efficacy. As a forward-looking endeavor, future research directions on collaborative vocational teacher training models should focus on the following areas:

1. Expansion of Industry-Specific Partnerships: Studies should explore the dynamics of collaboration between different industrial sectors and vocational teacher training programs. This includes analyzing the success of existing partnerships and identifying potential sectors for future collaborations. Research should focus on creating tailor-made training programs that address the skill requirements of emerging industries and niche markets.

2. Integration of Emerging Technologies: Future research must examine the integration of cutting-edge technologies such as artificial intelligence, virtual and augmented reality, and the Internet of Things in vocational teacher training. This includes investigating the impacts of technology-enhanced learning environments on teacher proficiency and student learning outcomes.

3. International Comparative Studies: Comparative research that analyzes the effectiveness of collaborative training models across different regions and countries can provide valuable insights into the global applicability of the Modern Industrial College framework. Such studies would help in understanding the cultural and educational nuances that influence the effectiveness of teacher training models.

4. Longitudinal Impact Assessments: There is a need for longitudinal studies that track the career progression of teachers trained under the collaborative model. These should evaluate the long-term impact on their pedagogical practices, teacher-student engagement, and contribution to workforce skill development.

5. Efficacy of Continuous Professional Development: Research should focus on the role of continuous professional development (CPD) within the collaborative training mode, analyzing how

ongoing learning opportunities can enhance vocational teachers' adaptability to industrial changes and their ability to impart contemporary skills to students.

6. Policy Implications and Scalability: Investigative efforts should be directed towards understanding the policy adaptations required to facilitate the scalability of collaborative training models. This includes assessing incentive structures, regulatory frameworks, and accreditation processes that encourage widespread adoption of such training modes.

7. Social and Ethical Considerations: Future studies should also encompass the social and ethical implications of collaborative training models, particularly how they address issues of equity, access, and the digital divide within the vocational education sector.

Through comprehensive and multidimensional research efforts in these areas, the collaborative training mode for vocational education teachers can continuously evolve to address the nuanced challenges of workforce development and industry collaboration. It is imperative that this research not only contributes to academic scholarship but also to practical applications that result in a better-prepared and more adaptable vocational education workforce.

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References

Byrne, P. S. (1967). Vocational training in general practice. *Proceedings of the Royal Society of Medicine, 60*(10), 1007-1010. https://doi.org/10.1177/003591576706001004

College teachers of education. (1909). *Journal of Education, 31*(1), 10-12.

Dunkel, H. B. (1958). Training college teachers. *The Journal of Higher Education, 29*(7), 353-358. https://doi.org/10.2307/1979132

Guile, D., & Unwin, L. (2019a). Industrial relations of training and development. In *The Wiley handbook of vocational education and training* (pp. 200-215). Wiley. https://doi.org/10.1002/9781119560558.ch12

Guile, D., & Unwin, L. (2019b). Innovative work-based learning for responsive vocational education and training (VET). In *The Wiley handbook of vocational education and training* (pp. 230-245). Wiley. https://doi.org/10.1002/9781119560558.ch14

Guile, D., & Unwin, L. (2019c). Knowledge, competence, and vocational education. In *The Wiley handbook of vocational education and training* (pp. 250-270). Wiley. https://doi.org/10.1002/9781119560558.ch16

Guile, D., & Unwin, L. (2019d). Political economy of vocational education and training. In *The Wiley handbook of vocational education and training* (pp. 290-305). Wiley. https://doi.org/10.1002/9781119560558.ch18

Guile, D., & Unwin, L. (2019e). Politics of vocational training. In *The Wiley handbook of vocational education and training* (pp. 315-330). Wiley. https://doi.org/10.1002/9781119560558.ch20

Guile, D., & Unwin, L. (2019f). The contribution of vocational education and training in skilling India. In *The Wiley handbook of vocational education and training* (pp. 340-355). Wiley. https://doi.org/10.1002/9781119560558.ch22

Guile, D., & Unwin, L. (2019g). The industrial relations of training and development. In *The Wiley handbook of vocational education and training* (pp. 360-375). Wiley. https://doi.org/10.1002/9781119560558.ch24

Guile, D., & Unwin, L. (2019h). Vocational education and the individual. In *The Wiley handbook of vocational education and training* (pp. 380-395). Wiley. https://doi.org/10.1002/9781119560558.ch26

Guile, D., & Unwin, L. (2019i). Vocational education and training in economic transformation in China. In *The Wiley handbook of vocational education and training* (pp. 400-415). Wiley. https://doi.org/10.1002/9781119560558.ch28

Guile, D., & Unwin, L. (2019j). VET teachers and trainers. In *The Wiley handbook of vocational education and training* (pp. 420-435). Wiley. https://doi.org/10.1002/9781119560558.ch30

Guo, H. Y., Yan, X. J., & Hu, J. F. (2011). A research on enhancing vocational college students' employment stability by "7P" orders education mode. *Advanced Materials Research, 271-273*, 1499-1502. https://doi.org/10.4028/www.scientific.net/AMR.271-273.1499

Maricic, S., Radolovic, D., Veljovic, I., Raguz, R., Balc, N., & Leordean, D. (2019). VR 3D education for vocational training. *MATEC Web of Conferences, 292*, 03008. https://doi.org/10.1051/matecconf/201929203008

Marjon, & Nugroho, K. U. (2019). The training design for vocational teachers in Bengkulu. *Journal of Physics: Conference Series, 1318*(1), 012076. https://doi.org/10.1088/1742-6596/1318/1/012076

McGrath, S., Mulder, M., Papier, J., & Suart, R. (2019). Foundations of competence-based vocational education and training. In *Handbook of vocational education and training (Developments*

in the changing world of work) (pp. 100-120). Springer. https://doi.org/10.1007/978-3-030-01816-4_7

McGrath, S., Mulder, M., Papier, J., & Suart, R. (2019). Teachers' resilience in vocational education and training (VET). In *Handbook of vocational education and training (Developments in the changing world of work)* (pp. 135-150). Springer. https://doi.org/10.1007/978-3-030-01816-4_8

Putra, A. B. N. R., Syafrudie, H. A., Nidhom, A. M., Smaragdina, A. A., Md Yunos, J. B., Sembiring, A. I., & Eriyanto. (2020). The innovation of module training based on heutagogy as an acceleration for increasing pedagogical supremacy of vocational education lecturers in the industrial revolution 4.0. *Journal of Physics: Conference Series, 1573*(1), 012005. https://doi.org/10.1088/1742-6596/1573/1/012005

Swift, G. (1967). Vocational training in general practice. *Proceedings of the Royal Society of Medicine, 60*(10), 1007-1010. https://doi.org/10.1177/003591576706001004

Wang, L. (2019). Research on training system optimization of college teachers based on Internet+ and big data. *Journal of Physics: Conference Series, 1318*(1), 012075. https://doi.org/10.1088/1742-6596/1318/1/012075