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Scientific and Social Research

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Exploration on Building a Part-Time Job Platform for College Students: Taking Xi'an Medical College as An Example

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Abstract: With the rapid development of the economy and the continuous progress of society, the competition for talents is becoming more and more intense, and the employment pressure of college students is increasing sharply. More and more college students are choosing to do part-time jobs while studying to improve their communication and hands-on skills and lay a solid foundation for future employment. However, due to the people with malicious intents, the part-time job market has become a mess, and cheating, skimming, trafficking have occurred from time to time, which are a great threat to the students' safety. Besides, the enthusiasm of college students towards their part-time jobs will also be affected. This article is based on the innovation and entrepreneurship project, "Blueberry Part-time Job," for college students at Xi'an Medical University, which provides a reference for the regularization of part-time jobs for college students and the construction of a part-time job platform for college students.

Keywords: College students; Campus part-time job; Platform construction; Formal

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1. Background

According to a survey, after the pandemic ended, about 70 % of college students were willing to do part-time jobs, but only 20% of college students were engaged in part-time jobs ^[1,2]. Through the statistics of this project, it was found that most of the college students who were willing to engage in part-time jobs but have never done part-time jobs were because they do not trust part-time jobs platforms or that they could not find suitable part-time jobs. However, some college students who had participated in part-time work were deceived and they did not know how to protect their rights. As a result, they let go of the issue and become less enthusiastic about their part-time work. From the perspective of social market demand, part-time jobs are beneficial to both college students and employers. With the penetration of Internet+ into all walks of life, employers and college students generally have a high degree of acceptance of the Internet and are very interested in and willing to use emerging Internet platforms ^[3]. Therefore, it is imminent to build a part-time job platform that is standardized and trusted.

2. The status quo of part-time jobs for college students

2.1. Information mismatch between supply and demand

Through an investigation of the students of Xi'an Medical College and the surrounding universities and various part-time recruitment platforms and employers in Xi'an, it was found that just the college students

of more than 1,000 part-time jobs are needed for Weiyang Campus of Xi'an Medical College every day. Employers that were investigated needed more than 30 part-time workers per day on average, which is more than enough to satisfy the demands for part-time jobs college students. However, there is still a situation where students cannot find part-time jobs and employers cannot find employees. This is because on one hand, there are few ways for college students to obtain information about part-time jobs, and the authenticity of part-time information is only about 50%. College students are not good at discerning this information, and college students with part-time ideas and needs do not have a credible way to obtain proper information. On the other hand, the employer has no effective and direct way to release part-time job information to the employees. Employers can choose to market their jobs through the so-called “intermediary,” but the commission is too high, which exceeds the value created by the part-time job itself, so they give up, resulting in difficulties for employers who really need part-timers.

2.2. Limited methods of job seeking and head-hunting

A survey found that only a small number of students participated in part-time jobs through direct recruitment by employers and introductions from friends. Most students obtained part-time job information through QQ, WeChat part-time job groups, and online part-time job platforms. Nearly half of the students responded that they could not get a part-time job, or that they were relieved by the agency or the employer after getting a part-time job. Sometimes, the actual job scope was inconsistent with the recruitment information or even violated the life and property safety of college students and national information security [2,4,5].

Employers usually rely on the referral of individuals or intermediary companies without formal procedures to obtain human resources, which often consumes a lot of manpower and financial and material resources, and it is difficult to find a suitable candidate. Besides, there is no formal contract between part-time workers and employers, so in some cases, the employee fails to complete the work as agreed, or the employer is unwilling to provide safety training and personal insurance, which are not conducive to the protection of the rights and interests of both parties [6].

Therefore, providing college students with a high-quality, convenient, safe, and reliable part-time job service, and creating an efficient link between employers and part-time college students, and building a standardized part-time job platform has a broad market prospect.

3. Social part-time job platforms

At present, the part-time job platform for college students has become a market full of opportunities and challenges. With the advancement and development of Internet technology, more and more platforms have emerged: undergraduate entrepreneurs providing college students with part-time jobs, Part-time Cats, and so on. These platforms continue to innovate business models, improve platform user experience, and strive to stand out in the fierce market competition [5-9]. However, there are some problems in these platforms.

Through an investigation of the part-time job platforms around Xi'an Medical University and the part-time job apps, it was found that most of the platforms on the market are owned by intermediary companies and are only used for salary payment, while the part-time job information is still disseminated through QQ accounts created by intermediary companies, WeChat groups, lower-level agents, part-time job groups, etc. After subcontracting layer by layer, part-time college students often end up receiving less than 2/3 of the salary paid by the employer [10, 11]. In addition, there are huge hidden dangers in the part-time college students. Because employers recruit personnel through outsourcing companies and there is no paper employment contract, it is often difficult for college students to protect their rights when their life and property safety is violated; most of the part-time apps have little reviews. As a result, it is difficult to distinguish whether information uploaded is true or false, and part-time college students often get scammed.

Some overseas institutions even take advantage of the lack of social experience of college students to lure college students to participate in illegal and criminal activities with high salaries and low-intensity jobs, which will have a certain impact on the future development of college students, and even endanger social security, life and property safety of college students, and national information security^[8,12]. Therefore, it is necessary to build a standardized and professional part-time job service platform for college students.

4. Platform business philosophy

“Blueberry Part-Time Job” is a platform integrating online recruitment information release, online registration, offline work, and salary payment. Employers only need to post job requirements, estimated working hours, work location, salary, and other information on the platform. In addition, the platform will determine the priority of new information released by employers based on the reviews of students who have worked at the establishment, so that other students can obtain more personalized part-time job information. The students will not be charged any fees, no additional fees will be charged to the employer except for a small amount of intermediary fees. Besides, there will also be no disguised charging methods such as VIP member fee on the platform. In addition, the platform provides legal assistance for both parties, protects the legitimate rights and interests of both parties, and creates a safe and reliable part-time job environment.

5. Platform operation method

Blueberry Part-time Job is operated by the a team and college representatives, college students and employers, and some intermediary companies with good credits. The recruitment information will be released by the employer or intermediary company, and the college students will sign up online, sign in and work online or offline. The students will be selected by a two-way scoring system^[12-14]. At the same time, in order to avoid fake reviews, real-name authentication is needed, and manual authentication is done by the operators from time to time, thus promoting a virtuous circle in the part-time job market. The participation of school representatives has also greatly improved the trust of college students in the part-time job platform. The injection of the petty cash by the platform also prevents college students from earning nothing due to employers or intermediary companies not paying them, therefore college students can be guaranteed to have a legal income. The profit model of the platform mainly includes commission fee, advertising income, activity sponsorship, enrollment commission and so on.

6. Platform content

6.1. Student platform service design

After the students contact the platform, they will come to the real-name authentication interface. After passing the real-name authentication, they will bind the student’s “Zhima reputation points” to the receiving account, and students will get 100 initial credit points, and upon that, they start looking for part-time jobs. Part-time jobs are prioritized according to the reputation and reviews of the employer and intermediary company. After the student’s part-time job ends, the employer can transfer the money to the student’s receiving account through the platform. If the employer fails to pay the student for more than three days, the student will be paid by the platform’s reserve fund upon verification. If a huge amount of salary is involved, the issue will be reported to the Public Security Bureau.

6.1.1. Home page design

The home page presents the core information of the platform in a clear, concise, and good way, including part-time job information in different places, high-quality merchants recommended by the platform, and the advantages and characteristics of the platform, etc., so as to attract college students^[15].

6.1.2. Part-time job information display page design

In the part-time job information display page, the information of the part-time job is provided in detail, including key information such as job nature, working hours, working location, salary, etc., and personalized tags are designed to facilitate users to search and filter.

6.1.3. Business information display page design

The information display page presents key information such as the size of the business, products or services in a clear and concise way, so that college students can better understand them.

6.1.4. Search and filter page design

The search and filter page is simple and easy to use where users can filter out part-time job information that meets their own conditions.

6.1.5. User registration and login page design

The design of the registration and login page is simple and clear, and at the same time, some short instructions are provided to help users complete related operations.

6.1.6. Order management page design

The order management page should have a clear and concise design, and is easily operated. Users can check the part-time job information they have applied for and the application status on the page.

6.1.7. Personal information management page design

The personal information page allows users to modify their personal information, and the information is well-organized, so that users can view their own evaluation and corresponding feedback.

6.2. Employer platform service design

Employers also need to undergo real-name authentication and they would also need to provide additional documents such as a business license to obtain 100 initial reputation points. After posting the recruitment information, it is necessary to attach job training and safety training outlines and pay a security deposit to the platform. In addition, employers can view the information of college students who intend to work part-time and choose whether to hire them according to the job requirements. There are also several design requirements for the employer platform service design.

6.2.1. User-friendliness

The employer service platform has a simple, understandable, and easy-to-operate interface design, which can help merchants complete relevant operations quickly through a few clicks and steps.

6.2.2. Diversified services

The employer service platform includes a variety of service types, including part-time job information release, job applicant screening, salary settlement, employee management, and other services.

6.2.3. Security guarantee

The employer service platform needs to have high security measures to ensure that the part-time job information uploaded on the platform will not be leaked, and it is also necessary to ensure the privacy of job seekers ^[16,17].

6.2.4. Data analysis function

The employer service platform needs has a data analysis function and can put forward suggestions and optimization plans based on the data analysis results of merchants and employees, so as to further improve work efficiency and service quality.

6.2.5. Customization

The employer service platform can be customized according to the needs of merchants to provide more considerate and flexible services.

6.2.6. Good service experience

The employer service platform needs to establish a comprehensive customer service system to provide merchants with high-quality and efficient service experience in order to gain the trust and support of merchants.

6.2.7. Timely communication

The employer service platform needs to establish instant communication channels to facilitate communication between employers and platform operators, so as to ensure timely resolution of problems and feedback.

Through the realization of the above design requirements, high-quality and efficient services can be provided for merchants, and the competitiveness and market position of the part-time job platform for college students will be improved.

6.3. Two-way scoring system

Two-way scoring is the most important part to reflect the reputation of both the supply and demand sides, and it is an intuitive manifestation of the competitiveness of both parties. After the student's part-time job is over, the student and the employer can rate each other and adopt the star scoring method. As a result, students with more stars will have better part-time job opportunities, and employers with more stars can be prioritized in the display page. If the student is late, absent from work, or has any misconduct, the employer can deduct the student's credit score in addition to giving a low star score. Students with credit scores that are too low will be prohibited from entering the platform, and the record of keeping promises can increase the credit score by a small amount. On the other hand, in the case of wage deduction, beating and scolding of employees, students can deduct the credit score of the employer and apply for compensation at the same time, in addition to giving low star ratings. Employers with low credit scores will be prohibited from entering the platform, and their deposit will not be refunded. The employer can only apply to restore a certain percentage of deducted credit points after obtaining the student's permission. In order to prevent the operator from tampering with the scores, the login password of the two-way scoring system are saved by the project responsible team and the school representative, respectively, and are only logged in during system maintenance.

6.4. Grievance service

Appeal services are provided in the event of conflicts and disputes between the two parties. The appeals are handled by the project team in terms of customer service, legal services will be provided by professional lawyers, and preliminary negotiation and mediation will be conducted between the two parties. In the event that negotiation and mediation fail, the complaint customer service can guide the victim to go to the relevant government department to seek a solution, and lawyers can provide legal consulting services. In the case of criminal cases, the complaint customer service will choose to call the police and actively provide relevant

evidence and clues ^[18-20].

7. Prospects

The development prospect of the part-time job platform for college students is very broad. With the progress and development of society, people's living standards continue to improve, and the demand for part-time jobs is also increasing. For college students, they need a job that can improve their communication, hands-on abilities, personal qualities, and financial income. Therefore, part-time jobs are the most suitable way to meet their needs at the university stage.

In the future, with the development of Internet technology, the market space of part-time job platform for college students will continue to expand. By building a comprehensive network platform, more part-time job information and opportunities can be provided for college students, and the process of recruiting and hiring can be simplified, and work efficiency and management level can be improved. At the same time, the part-time job platform for college students can also provide more flexible and high-quality labor resources for enterprises, reduce enterprise costs and risks, and improve enterprise competitiveness. This will also promote the development of the employment market for college students by providing more employment opportunities and economic contributions to society ^[14].

According to our project operation, we found that a formal and professional college student part-time job platform has good market prospects and social influence. The Blueberry Part-Time Job built by us serves the college students of Xi'an Medical University and some excellent units and companies in Xi'an. The project has been highly recognized since its operation, and employers and college students are able to develop and progress together. After the market research in the early stage of the project, it was found that although there are many part-time job platforms in this city, fake platforms account for a large proportion, and the high-quality platforms are less known, and often only have the function of paying wages. A large amount of part-time job information is released through part-time job group chats, and the credibility is not high. The multi-party intervention and two-way scoring operation model of this project has great advantages in terms of ensuring credibility. It not only saves manpower, material and financial resources for employers, but also provides safe and reliable part-time jobs for college students. Therefore, it has great potential for future development.

8. Conclusion

With the end of the three-year pandemic, more and more college students have stepped into society. Part-time jobs for college students has always been available, but solutions are needed for the problems in these jobs. The establishment and development of the platform requires the joint efforts of the country, society, enterprises, and college students, so that they can work together to promote the process of talent training, improve the employment of college students, and contribute to corporate recruitment.

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References

- [1] Shi G, Yan Z, Li Z, et al., 2020, The Demand and Future Prospect of the Development of Part-Time Service Platform for College Students. *Changjiang Series*, 2020(32): 122–123.
- [2] Zhang X, Li Y, Ning T, et al., 2022, Investigation of College Students' Social part-time job and Analysis of its Influencing Factors. *Gansu Science and Technology*, 2022(09): 73–75+85.
- [3] Bo S, Jing P, Zhang M, et al., 2019, Reflections on the Construction of a Part-time Job Platform for Art College Students Based on “Internet +”. *Contemporary Tourism*, 2019(06): 286.
- [4] Zhang X, 2023, Problems Existing in College Students' Part-Time Jobs and Countermeasures [J]. *Shanxi Youth*, 2023(02): 150–152.
- [5] Zhang H, Li Z, Zhang J, 2020, Research on the Construction of College Students' Part-time Job Platform under the Background of Internet +. *Fortune Today*, 2020(01): 32.
- [6] Lu W, 2020, Analysis on the Investigation and Establishment of College Students' Part-time Job Platforms. *Farm Staff*, 2020(12): 206.
- [7] Qiu Y, Zhang X, Li H, et al., 2023 Analysis of Influencing Factors of College Students' Part-time Job Satisfaction. *Cooperative Economy and Technology*, 2023(03): 99–101.
- [8] Zhang Y, Rong Y, Du X, et al., 2023, Problems and Countermeasures of Part-Time Jobs for College Students. *Cooperative Economy and Technology*, 2023(04): 93–95.
- [9] Zhou A, Li Y, Wei Y, 2023, An Empirical Study on the Impact of Part-time Jobs on College Students' Studies and Employment in Beijing. *Cooperative Economy and Technology*, 2022(14): 103–105.
- [10] Kong X, Lu J, Yu Q, 2021, Thoughts on the Construction of WeChat Platform for Part-Time Intermediary College Students. *Modern Commerce and Industry*, 2021(15): 41-42.
- [11] Liang H, Wang N, Li T, et al., 2019, Research on the Problems and Countermeasures of College Students' Part-time Jobs - Exploring the Establishment of a Unified Part-time Job Service Platform for College Students. *Knowledge Economy*, 2019(06): 167–168.
- [12] Wang Q, Chen F, 2020, Thoughts on the Safe Part-time Job Information Service Platform for College Students. *Value Engineering*, 39(03): 269–271.
- [13] Zhang Q, Zhang J, Bao Z, et al., 2022, Optimization Research on Construction of College Students' Part-time Job Platform Based on Blockchain Application Technology. *Network Security Technology and Application*, 2022(04): 62–64.
- [14] Shu C, Zhang J, Liu Z, et al., 2019, Research and Application Based on the Part-Time Job Platform System for Contemporary College Students. *Industry and Technology Forum*, 2019(23): 121–122.
- [15] Chen M, Zhou W, 2019, Research Based on the Construction of College Students' Personalized Part-time Job Platform —— Taking Nanning Wuhe University City as an Example. *China Logistics and Purchasing*, 2019(14): 41.
- [16] Hu X, Lin R, 2019, Thoughts on Building a Third-Party Platform for College Students to Work Part-Time. *Legal Expo*, 2019(01): 37–38.
- [17] Zhu X, Shi Y, He F, 2021, Research on Consumption Choices and Online Platform Legal Responsibilities in College Students' Part-time Jobs. *Business Exhibition Economy*, 2021(13): 58–60.
- [18] Dong J, Liu C, Lu Q, 2022, Based on the Analysis of the Current Situation of Part-Time Jobs for College Students in Jiangsu Province and the Investigation of Rights Protection. *New Economy*, 2022(07): 73–77.
- [19] Hao W, Wang Y, 2021, Investigation and Research on the Legal Protection of College Students' Off-

Campus Part-Time Jobs. Education and Teaching Forum, 2021(51): 41–44.

[20] Chen J, 2021, Research on the Path to the Protection of College Students' Part-time Labor Rights and Interests. Legal Expo, 2021(26): 12–14.

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Separation or Integration: Analysis about the Theories of Vocational Enlightenment Education Courses

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Abstract: Currently, vocational enlightenment education is being implemented in various forms in some primary and secondary schools, but there is still an ongoing exploration of the recognized forms of vocational enlightenment education. The two main forms of vocational enlightenment education at present are independent implementation in a separation-based approach and integration with other disciplines. Analyzing the basic forms of vocational enlightenment education through the lens of disciplinary development theories such as disciplinary training and interdisciplinary studies can help us understand its construction foundation as well as the pros and cons of its development. In order to establish a unique form of vocational enlightenment education curriculum, it is necessary to clarify its distinctive features, delineate its knowledge domain, and establish disciplinary boundaries. Through a continuous process of standardization, scientific development, and stability, vocational enlightenment education can transcend disciplinary boundaries and integrate with related courses to innovate its distinctive practical approach.

Keywords: Vocational enlightenment education; Vocational enlightenment education courses; Interdisciplinary

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1. Introduction

The question of how vocational enlightenment education courses exist in what form has been the focus of existing research. Most studies have explored how to integrate vocational enlightenment education into related courses, such as labor education, comprehensive practical activities, and major cultural courses. Some scholars argue that vocational enlightenment education should not be limited to being an add-on to certain courses, but rather be considered as an independent curriculum. They emphasize the need to construct a complete, independent, and scientific vocational enlightenment education system^[1]. According to John I. Goodlad's classification of curriculum, vocational enlightenment education courses are currently considered an "ideal curriculum." Relevant policies advocate the implementation of vocational enlightenment education at primary and secondary school stages, but there are no specific curriculum plans or standards. Whether to integrate vocational enlightenment education into a comprehensive course or to establish it as a separate and independent course requires a theoretical analysis based on practical considerations such as curriculum content and form, examining the potential mechanisms for the separation

or integration of vocational enlightenment education courses.

2. Separation of vocational enlightenment education courses

2.1. Separation of vocational enlightenment education courses and other courses

To analyze the current status of the separation of vocational enlightenment education courses, it is necessary to define their content based on the assumption of their separation. Vocational enlightenment education courses refer to the induction and integration of vocational enlightenment elements covering different occupations. They can be divided into knowledge domains that constitute an independent and relatively mature vocational enlightenment education curriculum system. This allows vocational enlightenment education to be implemented within the scope of school education in the form of designated independent class hours. Currently, independent vocational enlightenment education courses are mainly developed in secondary vocational schools. However, there are no unified curriculum standards, teaching syllabi, or instructional designs. Additionally, there is a lack of effective coordination between vocational enlightenment education courses at different educational stages. When comparing vocational enlightenment education courses with labor education courses and comprehensive practical courses, each has its emphasis and characteristics.

From the perspective of curriculum development, comprehensive practical activity courses focus on students' personal development, targeting their life contexts. These courses aim to enable students to gain experience and understanding of life and nature, integrate knowledge from various disciplines, and cultivate abilities to solve problems, take responsibility, and materialize creativity. The goal is to help students form a value system. Labor education courses, on the other hand, are directed toward students' labor contexts. They aim to shape students' positive values and spirits regarding labor, cultivate labor habits and abilities, and ultimately promote the comprehensive development of students' qualities. Vocational enlightenment education, based on students' future career development needs, is oriented toward the work contexts of various occupations. The purpose is to initially cultivate vocational awareness and skills, guide vocational interests, and form correct vocational values.

In terms of current curriculum content, developed vocational enlightenment education courses in secondary vocational schools mainly focus on DIY handicrafts or labor-related technical content, which have a relatively weak vocational orientation. The content of comprehensive practical activity courses is based on various activity themes, such as science and technology, arts, and ethics. This allows students to establish intrinsic connections with society and nature through their participation in these activities. The main content of labor education courses includes knowledge, skills, and values related to daily life labor, productive labor, and service-oriented labor. The content of labor education courses has progressively advanced across different educational stages. In primary school, the focus is on labor within students' personal lives, school, and family. In junior high school, emphasis is placed on engaging in labor both within and outside the school, including productive labor and service-oriented labor. In high school, there is an emphasis on experiencing labor in vocational.

In terms of curriculum implementation, comprehensive practical activity courses are conducted through methods such as investigation and exploration, community service, design and production, and experiential learning. Labor education courses are primarily implemented through activities such as labor weeks, special lectures, thematic speeches, labor skills competitions, labor achievements exhibitions, and practical labor projects. The implementation methods of vocational enlightenment education courses are still being explored. Currently, the main forms of implementing vocational enlightenment education include vocational enlightenment days, vocational research, vocational role-playing, and other forms of vocational experiences outside the classroom. Inside the classroom, activities such as handicraft making, creative living, and traditional Chinese medicine health practices are incorporated into the curriculum, drawing on

local development and relevant international experiences ^[2].

2.2. Theories about the separation of vocational enlightenment education courses

The practical forms of the curriculum can be traced back to the historical development of “disciplinary training” and the institutionalization of disciplines. “Disciplinary training” is both an institution and an educational practice that refers to the evaluation of the effectiveness and legitimacy of knowledge based on certain scientific standards, as well as the categorization, coordination, and regulation of the boundaries and hierarchical status of knowledge. This concept is derived from the combination of the two concepts, “discipline” and “training.” “Discipline” has two basic meanings: one is the different fields of knowledge and subjects of study, and the other is the strict regulation and shaping of human development according to certain standards, which is known as disciplinary training. The term “training” was initially introduced by Foucault, referring to “the normalization of training.” It was later developed and updated by scholars such as Wallerstein and Hawkins in the United States. They emphasized the “educational practice” between knowledge and power and revealed the forms of power and knowledge within this “educational practice.” They introduced the concept of “disciplinary training” to elucidate the institutionalization process of disciplines.

Wallerstein’s research on social sciences points out that from the 19th century to the mid-20th century, the emergence of social science disciplines such as economics and sociology facilitated the institutionalization process of disciplines. Among various disciplines, especially those with similar research content, attempts were made to delineate the boundaries of knowledge in order to establish and regulate their unique domains. While there may be some overlap between vocational enlightenment education courses and comprehensive activity courses or labor education courses, each has its emphasis and characteristics. This is a necessary condition for the vocational enlightenment education curriculum to separate itself from related courses and form its own system. If vocational enlightenment education is to establish an independent curriculum system, it is also necessary to clearly delineate independent knowledge domains in order to consolidate the identity of the curriculum.

The establishment of curriculum identities is inevitably influenced by various aspects such as socioeconomic factors, political power, and culture, which in turn impact the boundaries, extent of development, and differentiation or recombination of different disciplines. One assumption of the sociology of knowledge suggests that the organization of school curriculum, academic disciplines, and the production and development of knowledge are to varying degrees influenced by social class, gender, and race. While this is considered an exploratory assumption by scholars, Michael F.D. Young also emphasizes that “it is never in itself a reason for supporting (or opposing) a particular curriculum.” However, it does provide an analytical framework for understanding the existence and forms of vocational education curricula.

The traditional ideologies of “officialdom” and “education leading to official positions” continue to exert influence to this day, and subject-based curriculum still holds a prominent position within the primary and secondary education system. Furthermore, the negative societal attitude towards vocational education has, to some extent, hindered the implementation of vocational enlightenment courses in primary and secondary schools ^[3]. Through a case study of a primary school, it was found that elementary school students have a narrow understanding of professions. The formation of vocational aspirations in such a state may have varying degrees of negative impact on individual students or socio-economic development. Vocational enlightenment education should serve as the foundation of the modern vocational education system, and its curriculum design needs to adapt to the socio-economic development and trends in talent cultivation. The independent manifestation of vocational enlightenment education courses is of significant importance in this regard ^[4].

2.3. Advantages and disadvantages of the separation of vocational enlightenment education courses

To establish a relatively independent vocational enlightenment education curriculum system, it is essential to popularize public awareness of vocational enlightenment education and have more independence in terms of content and implementation. On the other hand, public recognition can also promote the in-depth development of vocational enlightenment education, increase investment in the development of vocational enlightenment education courses, gradually establish a mature vocational enlightenment education curriculum system, and create an internal virtuous cycle. However, the current development of the vocational enlightenment education curriculum is just in its early stages, and to truly build a more mature curriculum system and achieve the separate development of vocational enlightenment education courses, several conditions need to be established as the foundation. Vocational enlightenment education courses need to achieve coordination and overall planning with other related courses in terms of content and implementation, rationalizing the division of overlapping areas and emphasizing their characteristics. In addition, introducing a new course poses a major challenge to the development of primary and secondary education, requiring further exploration in curriculum development, allocation of teaching hours, teacher selection and training, and the selection and construction of vocational experience bases. Due to the immature development of vocational enlightenment education in our country, scholars also need to continuously explore localized vocational enlightenment education courses based on lessons learned from foreign curriculum development experiences. The separate development of vocational enlightenment education courses requires certain concessions and changes from relevant disciplines, as well as the joint efforts of government, schools, scholars, and other stakeholders. The government plays a guiding role by providing legal, financial, and other guarantees. Vocational colleges not only provide vocational and professional information and experiential venues but also develop vocational enlightenment education courses and supply vocational enlightenment teachers to primary and secondary schools. Primary and secondary schools, as the main implementers of vocational enlightenment education, need to effectively implement the curriculum and conduct timely evaluation and feedback. Relevant social enterprises and vocational enlightenment education venues actively participate in cooperation to support the separate development of vocational enlightenment education courses [5].

3. Syncretism of vocational enlightenment education courses

3.1. Syncretism of vocational enlightenment education courses and other courses

The vocational enlightenment education curriculum exhibits partial intersections in terms of content, format, and resources with integrated practical courses, labor education courses, and major cultural courses. This mode of vocational enlightenment education, based on interdisciplinary intersections, constitutes the integrated manifestation of the vocational enlightenment education curriculum.

There is an overlap in terms of curriculum content and format. The vocational enlightenment education courses developed by vocational schools, with content names such as “Colorful Weaving,” “Ribbon Accessories,” and “Fan Art,” are referred to as vocational experiential courses. Vocational experience is one of the implementation forms of integrated practical courses, thus there exists an overlap between vocational enlightenment education courses and design-oriented or labor-oriented courses within integrated practical activities. In primary and secondary schools, vocational enlightenment education is often implemented through practical activity classes. However, these types of content mainly emphasize students’ hands-on abilities, focusing to some extent on cultivating their craftsmanship and environmental awareness, rather than having a strong vocational orientation. In reality, this does not align well with the definition of vocational enlightenment education courses established by most scholars. The essence of vocation is labor, which includes labor in vocational job positions and labor in life situations. Moreover, labor cannot be separated from hands-on practice. From this perspective, the content covered by labor education courses

includes some aspects of integrated practical activities and vocational enlightenment education courses. Therefore, vocational enlightenment education courses and integrated practical activity courses can also be considered methods of implementing labor education.

Additionally, there is an intersection of teaching staff in the curriculum. Vocational enlightenment education is mostly implemented by subject teachers, vocational college teachers, or specially trained teachers from schools. Labor education courses and integrated practical activity courses have dedicated teachers, while some primary and secondary schools assign subject teachers to teach these courses. Currently, vocational enlightenment education is mainly conducted through offline vocational experiential activities. The sharing of teaching staff for its curriculum remains at a superficial level of inter-school guidance, such as vocational college teachers and vocational enlightenment education experts being stationed in regular primary and secondary schools and vocational enlightenment education centers to provide guidance on curriculum implementation and development. As there is more room for selecting and utilizing teaching staff in vocational enlightenment education courses, there are more paths worth exploring for sharing teaching staff with the other two courses.

Moreover, there is a fusion of curriculum hardware resources. Vocational enlightenment education, labor education, and integrated practical activities share common venues for implementation, including classrooms, on-campus and off-campus vocational experiential sites, vocational schools, and enterprise institutions. In terms of equipment, in addition to physical devices, networked digital resources serve as more efficient and convenient forms of resources. However, their application in these courses is limited, yet they are indispensable and represent latent hardware resources that are waiting to be developed. If better developed and utilized, they will also serve as important conditions for the integration of vocational enlightenment education courses with other courses ^[6].

3.2. Theories about the syncretism of vocational enlightenment education courses

The analysis of the separation and integration of vocational enlightenment education courses can be inspired by the development of disciplines. The separation and integration of disciplines have been reflected in the debate over the status of science and philosophy. In the 17th and 18th centuries, science and philosophy were considered “independent and equal” allies in the pursuit of truth about the world. Since the 19th century, intellectual history witnessed the specialization and professionalization of knowledge, with knowledge being systematically divided into different knowledge clusters and forming multiple disciplines such as history, economics, sociology, and political science. Different disciplines took different epistemological positions, leading to a situation where science and philosophy were seen as completely distinct or in direct opposition, with science gradually gaining overwhelming dominance. Since 1945, there has been a growing pursuit of more precise knowledge, leading to the blurring of disciplinary boundaries and an emphasis on interdisciplinary integration while disregarding disciplinary differentiation. Efforts to eliminate disciplinary organizing forms and promote interdisciplinary or anti-disciplinary research have emerged. The emergence of “area studies” has further fostered close connections between different disciplines, particularly emphasizing collaboration and achievements between individual-focused historical disciplines and generalizing social sciences. The three traditional social science disciplines have gradually overlapped in terms of research subjects and methodologies, creating opportunities for the emergence of interdisciplinary fields. In the 1960s and 1970s, the interrelation and boundary-crossing of knowledge domains were extensively explored, and collaboration among different fields of knowledge was increasingly valued. Social sciences, humanities, and natural sciences became “potential places of self-harmony.” Communication, collaboration, and even integration between disciplines have become important directions for the development of disciplines, providing a theoretical perspective for the integration of vocational enlightenment education courses.

In the 19th century, universities established various departments by “dividing and classifying” disciplines, and the boundaries thus established were changeable. These disciplinary boundaries can be used to delineate fields of knowledge and facilitate cross-disciplinary permeation of different disciplinary contents. The stronger the exclusivity and stability of the knowledge domain of a discipline, the less likely it is for cross-disciplinary permeation to occur. This is a manifestation of the institutionalization of disciplines. Currently, vocational enlightenment education has not formed a stable knowledge domain and knowledge structure. Practical experience indicates that there is a basis for disciplinary permeation between vocational enlightenment education and related disciplines, providing possibilities for the integration of vocational enlightenment education courses with other relevant courses. Hollisstein argues that universalism is the pursuit of social sciences, but it is also a source of controversy because this “universality” needs to prove its narrowness to the public. Rebuilding an open social science requires addressing the problem of disciplinary segregation through collective discussions. Therefore, opening up social sciences, promoting interdisciplinary cooperation based on the narrowness of each discipline, and achieving “pluralistic universalism” are important forms of disciplinary development. With the development of knowledge updates and the information age, interdisciplinary integration is being increasingly discussed by scholars. The concept of interdisciplinary, first proposed by Woodworth, involves integrating information, data, skills, tools, perspectives, concepts, and theories from two or more disciplines or professional knowledge fields. It expands and deepens the knowledge of various disciplines and professional fields, or collectively addresses problems that cannot be solved by a single discipline or research field. The fused curriculum established through interdisciplinary approaches generally revolves around a specific theme and utilizes multiple disciplines to address practical issues. The current “comprehensive practice activity courses” are a concrete manifestation of fused courses.

Disciplinary training and interdisciplinary integration should not be seen as opposing forces; interdisciplinary integration needs to be based on the effectiveness and legitimacy of disciplinary knowledge within disciplinary training. Hawkins has upgraded the concept of disciplinary training and regards the disciplinary training system as a new knowledge ecosystem, where the knowledge domains are open and capable of endlessly generating new disciplinary training fields and sub-disciplinary training fields. Vocational enlightenment education intersects with the knowledge domains of comprehensive practice and labor education, which can jointly constitute a new integrated knowledge ecosystem. The interactions between the different knowledge domains can lead to the delineation of new disciplinary boundaries and the generation of new disciplinary training fields, potentially resulting in the creation of new fused courses from the three subjects. However, the emergence of these fused courses requires the establishment of knowledge domains within each discipline that are effective and legitimate. The development of social sciences promotes mutual cooperation between disciplines but needs to be based on the solid knowledge systems of each discipline and move towards “universality” while maintaining the uniqueness and relative independence of their knowledge domains. The intersection of vocational enlightenment education courses with other related courses in terms of themes, content, format, and resources constitutes partial conditions for integration. However, a crucial prerequisite for interdisciplinary integration is the maturity within each discipline. Vocational enlightenment education courses need to undergo their construction and development, which is closely related to the overall development of vocational enlightenment education. Given the current state of vocational education development, it will still take a considerable amount of time to establish a stable knowledge domain and system for vocational enlightenment education courses.

3.3. The possibility of integration between vocational enlightenment education courses and other related courses

Analyzing the integration mechanisms between vocational enlightenment education courses and other related courses requires a clear understanding of the driving forces and obstacles for integration. In terms of driving forces, vocational enlightenment education courses are currently lacking a mature curriculum system, with fragmented course modules and a lack of coherence between courses. It will take a considerable amount of time to explore how to establish a balanced “knowledge ecosystem” between vocational enlightenment education courses and related courses, allowing vocational enlightenment education courses to become independent, systematic, and well-integrated with other courses. In comparison, utilizing existing vocational enlightenment education course resources to improve, analyze, coordinate, and integrate them with the content of related courses can develop a brand-new course that not only includes shared general content before integration but also encompasses the respective focuses and characteristics of each course. This approach can more effectively mobilize collaborative course resources and generate greater benefits in course development. There is also currently a lack of “specialized” teachers for vocational enlightenment education. Vocational enlightenment education in primary and secondary schools is mostly implemented by teachers from vocational schools and other subject teachers. Training teachers for vocational enlightenment education would require significant financial and human resources. However, under the integration mode, there is no need to train new teachers specifically for vocational enlightenment education courses. Instead, training can be provided to existing teachers of related courses on the unique content of vocational enlightenment education. This approach can reduce the waste of course resources, financial resources, human resources, and time to some extent. Finally, the integration mechanism cannot be achieved without policy support. The exploration of the integration of vocational enlightenment education courses with comprehensive practice activities and labor education courses is a process of secondary development of the national curriculum. It is an important path to promote the reform of new curricula and a key initiative actively promoted by the education authorities.

In terms of integration obstacles, the content of courses will naturally increase under the integration mode. Scientific adjustments need to be made to the scheduling of class hours. While ensuring the integrity and effective implementation of the curriculum content, it should not negatively impact other cultural courses. Comprehensive practice activities and labor education courses have already become familiar components in primary and secondary schools. The former has been advocated as a compulsory course since 2001. Vocational experience serves as an activity theme in comprehensive practice activities and as an implementation form in labor education. The integration of vocational enlightenment education content will disrupt the relative stability of the existing curriculum to some extent. It will require a certain amount of time for adjustment and adaptation to truly integrate with these courses.

The integration of vocational enlightenment education courses with related courses forms a new curriculum, and consolidating itself is the foundation for achieving interdisciplinary integration. It is necessary to deepen the theoretical research of vocational enlightenment education, establish a comprehensive theoretical framework, and establish curriculum standards as guidance for curriculum development and implementation. It is also essential for establishing a resource coordination mechanism for vocational enlightenment education courses and related courses, fully mobilizing and utilizing resources from related courses, as well as establishing a communication and collaboration platform for stakeholders. Under the integration mode, more stakeholders are involved, requiring the establishment of more effective information communication and collaboration.

4. Conclusion

4.1. Separation or integration: The future development of vocational enlightenment education

Wallerstein and others do not unilaterally advocate for the separation or integration of disciplines. They point out that the effectiveness of disciplinary roles relies on the normativity and validity of disciplinary boundaries and, to some extent, achieving consensus. Similarly, interdisciplinary theory suggests that the benefits of interdisciplinary approaches are contingent upon the maturity of course content during specialization. Therefore, when discussing whether vocational enlightenment education courses should be separated from or integrated with other related courses, it is essential to clarify the disciplinary boundaries between vocational enlightenment education courses and related courses. Regardless of separation or integration, it is necessary to strengthen the distinctive features of vocational enlightenment education courses and continuously mature in terms of content and implementation. This requires further development and improvement of vocational enlightenment education courses and other related courses, enabling them to fully leverage their unique characteristics and achieve their educational objectives in the separation mode. In the integration mode, they should also combine the advantages of different courses to cultivate students' comprehensive qualities.

Based on this, the separation mode of vocational enlightenment education courses should serve as the foundation for the formation of the integration mode. The separation mode, as a transitional form leading to the integration mode, precedes the integration mode. However, the integration mode can continue to advance during the stabilization process of knowledge domains. Therefore, the development of distinctive features in the separation mode of vocational enlightenment education courses should be the current focus. Nevertheless, this process does not hinder the exchange and integration between the knowledge domains of vocational enlightenment education courses and related courses. Building upon the effectiveness, stability, and standardization of the vocational enlightenment education knowledge domain in the separation mode, considering the construction of a global community with a shared future for humanity and the promotion of global integration, an interdisciplinary collaboration among various disciplines is continually facilitated. Under the development of their knowledge domain characteristics, disciplines also transcend disciplinary boundaries, establish bridges for disciplinary communication and integration, and even give rise to new disciplines. The development of vocational enlightenment education courses will inevitably follow this recognized law of disciplinary development.

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Author contributions

F.Z. conceived the idea of the study. L.Y. wrote the paper. H.Z. and Y.Q. analyzed the data.

References

- [1] Gao S, 2022, From Experience to Vocational Path Design to Curriculum Development for Vocational Enlightenment Education. *J Vocat Educ*, 38(05): 56–64.
- [2] Gao S, 2020, Curriculum Construction: The Key to Career Enlightenment Education in Secondary Vocational Schools. *Contemp Vocat Educ*, 2020(01): 34–41. <http://doi.org/10.16851/j.cnki.51-1728/g4.20200115.004>
- [3] Dong T, 2022, Children's Vocational Enlightening Education: Dilemma, Value and Content. *Value and Content. Vocational Education Research*, 2022(03): 16–20.
- [4] Gao K, 2021, Value, Foundation and Path of Vocational Enlightenment Education in Small-Scaled Rural Schools. *Teaching & Administration*, 2021(21): 10–14.
- [5] Shao W, Wang G, 2021, Dilemmas and Breakthroughs of the Integration of Vocational Enlightenment Education Resources from the Perspective of Symbiosis Theory. *Educ Vocat*, 2021(07): 5–11. <http://doi.org/10.13615/j.cnki.1004-3985.2021.07.001>
- [6] Wu N J, Sun F, 2021, The Realistic Demands and Building Approach of Resource Sharing of Vocational Enlightenment Education. *J Vocat Educ*, 37(04): 20–25.

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A Brief Analysis of the Improvement of the Law of the People's Republic of China on the Protection of Cultural Relics

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Abstract: Since the promulgation of the “Law of the People’s Republic of China on the Protection of Cultural Relics” in 1982, the law has been amended five times and revised once. Among them, the revised version adopted on October 28, 2002, has changed remarkably. On the premise of sorting out its historical background, we take “The Provisional Regulations on the Protection and Management of Cultural Relics (1961),” “The Law of the People’s Republic of China on the Protection of Cultural Relics (1982),” and “The Law of the People’s Republic of China on the Protection of Cultural Relics (2002)” as the research subject to analyze the changes in legal provisions and reveal the process of improvement in the protection of cultural relics in China.

Keywords: Protection of cultural relics; The law; Legal articles

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1. Introduction

On November 10, 2020, the State Administration of Cultural Heritage (SACH) issued “A draft amendment to the Protection of Cultural Relics of the People’s Republic of China (Draft Amendment),” which is another major amendment to the law since it was enacted in 1982. Looking back on history, three laws and regulations have been extremely important in the legalization of cultural relic protection in China. They are “The Provisional Regulations on the Protection and Management of Cultural Relics (1961)” (hereinafter referred to as “Regulations (1961)”), “The Law of the People’s Republic of China on the Protection of Cultural Relics (1982)” (hereinafter referred to as “The Law of Protection (1982)”), and “The Law of the People’s Republic of China on the Protection of Cultural Relics (2002)” (hereinafter referred to as “The Law of Protection (2002)”). In this study, we attempt to analyze the changes in the specific articles of the three laws and regulations based on the background of the times and then reveal the process of improvement of China’s cultural relics protection law.

2. “Regulations (1961)” in the early years of the People’s Republic of China

In the early years of the People’s Republic of China, in order to rid the country of being impoverished and destitute, the whole country was actively developing industry and agriculture ^[1]. In capital construction projects, many immovable cultural relics had to make way for urbanization. Similarly, there were conflicts between the protection of cultural relics and the construction of farmland infrastructure in agricultural production and construction. In addition, laws and regulations were not perfect in the early years of China;

many cultural relics were lost overseas, and tomb raiding occurred from time to time.

In order to effectively balance the relationship between capital construction and protection of cultural relics, as well as to curb smuggling and looting, the Chinese government issued a number of measures, directives, and notices on a single issue between 1950 and 1958. It was not until 1961 that “Regulation (1961),” a comprehensive law, was promulgated, with 18 articles in total. As the predecessor of “The Law of Protection (1982),” this regulation laid the foundation for the premise of Chinese cultural heritage protection. Specifically, it includes defining cultural relics, formulating a protection and management system for immovable cultural relics, and clarifying the management methods for the circulation of movable cultural relics.

2.1. Definition of cultural relics

According to Article 2 of “Regulations (1961),” cultural relics can be classified into five categories:

- (1) buildings, sites, and commemorative objects related to major historical events, revolutionary movements, and important figures that have commemorative significance and historical data value;
- (2) ancient cultural sites, tombs, buildings, grottoes, stone carvings, *etc.*, of historical, artistic, and scientific value;
- (3) valuable art and crafts of all ages;
- (4) revolutionary documents and materials as well as ancient books and materials of historical, artistic, and scientific value;
- (5) representative objects that reflect the social system, social production, and social life of all times.

Such a definition not only emphasizes the importance of revolutionary cultural relics, but more importantly clarifies the three major values of cultural relics, namely historical value, artistic value, and scientific value.

2.2. The protection and management system of immovable cultural relics

In Article 4 of “Regulations (1961),” immovable cultural relics can be divided into three categories. Taking this as the framework of protection and management, the contents of protection and management are further stipulated in Articles 5 and 11 of “Regulations (1961).” The contents of protection and management include four aspects, *i.e.*, clarifying the management organization, determining the scope of protection, making signs and explaining, and recording files. In China, it is commonly known as “four-haves job.”

In addition, details such as the relationship between authority and responsibility, a coordinated approach to protection and development, and sources of funding have been highlighted in Articles 6, 8, 9, 11, and 12 in “Regulations (1961).”

2.3. Measures for the administration of circulation of movable cultural relics

In Article 13 of “Regulations (1961),” “Local departments for cultural administration shall strengthen their control over the commerce of cultural relics.” Furthermore, Article 14 of “Regulations (1961)” clearly states that “the export of important cultural relics is prohibited except those exported for exhibition or exchange approved by The State Council.” In addition, the state has the right to confiscate cultural relics when they are found to be stolen.

3. “The Law of Protection (1982)” in the initial stage of the Chinese reform and opening-up

Since the promulgation of “Regulations (1961),” Chinese cultural relics had been relatively protected. However, the punishment for criminals was too general. Illegal acts such as digging and smuggling still occurred. Moreover, as China entered a new era of “economic construction as the center,” the cause of cultural relics conservation has encountered new difficulties ^[2]. In addition, along with the promulgation of

various international documents on heritage protection, Chinese cultural relics protection workers also began to reflect on the focus of conservation.

On November 19, 1982, the National People's Congress promulgated "The Law of Protection (1982)" on the basis of integrating various normative documents already issued. As the first law promulgated by the country's top legislative body in the field of culture, the law contains 33 articles in 8 chapters and establishes the protection principle of "not changing the original state of cultural relics." Compared with "Regulations (1961)," in "The Law of Protection (1982)," the definition of cultural relics is more precise, the protection and management system is more ideal, the management measures for movable cultural relics are more considerate, the reward and punishment measures of movable cultural relics are detailed, and the importance of archaeological work is emphasized.

3.1. Precise definition of cultural relics

In terms of the precise definition of cultural relics, "The Law of Protection (1982)" embodies the definition of types and the formulation of space and time range. Specifically, in the law, vague words such as "*etc.*" do not appear (Article 2 of "The Law of Protection (1982)"). The space range is also restricted "within the territory of the People's Republic of China" and includes underground, internal waters, and territorial water. Moreover, the expression of time does not appear in such vague terms as "epochal," but "historical" instead (Articles 2 and 4 of "The Law of Protection (1982)").

3.2. Relatively ideal protection and management system of immovable cultural relics

On the basis of "Regulations (1961)," "The Law of Protection (1982)" is supplemented and improved in three aspects.

Firstly, in terms of the protection and management framework, the law adds "historical and cultural city" on the basis of the original three-level cultural relics protection units, as evident by Article 8 of "The Law of Protection (1982)."

Secondly, in terms of coordination with infrastructure construction, the law supplements the examination and approval methods for corresponding construction projects and adds the demarcation of construction control zones, as evident by Article 12 of "The Law of Protection (1982)."

Thirdly, in terms of reuse, the law clarifies the approval methods for changing the use of immovable cultural relics at all levels and details the protection articles, as evident by Article 15 of "The Law of Protection (1982)."

3.3. Deepen the management measures for movable cultural relics

In "The Law of Protection (1982)," the relevant articles on the circulation management of movable cultural relics amount to 7 articles in 3 chapters. First, the law defines movable cultural relics as museum collections and private collections and then grades them according to their value. Furthermore, corresponding circulation measures are formulated for different grades and categories of movable cultural relics, and various approval procedures are deepened and improved, as evident by Articles 24, 25, 27, and 28 of "The Law of Protection (1982)."

3.4. Refine the objects and measures of rewards and punishments

In "The Law of Protection (1982)," the regulations on rewards and punishments have been expanded into one chapter. The objects of rewards and punishments are subdivided into 7 situations. For different objects, incentive measures include spiritual encouragement and material rewards, while punitive measures are divided into administrative punishment and criminal responsibility according to severity, as evident by Articles 29, 30, and 31 of "The Law of Protection (1982)."

3.5. Chapter on archaeological excavations

In “The Law of Protection (1982),” contents related to “archaeological excavation” are summarized into one chapter. First of all, it is clear that “all archaeological excavations must go through the application for approval,” and no foreigner or foreign organization is allowed to carry out archaeological investigations or excavations without permission, as stated in Article 21 of “The Law of Protection (1982).” At the same time, the law also makes detailed articles on the proposal of excavation plans and sources of excavation funds, as evident by Articles 16, 19, and 20 of “The Law of Protection (1982).”

4. “The Law of Protection (2002)” in the early 21st century

With the gradual deepening of reform and opening-up and the greater demand for spiritual needs among people, urban construction, tourism development, market expansion, and other factors have brought unprecedented challenges to the protection and management of cultural relics ^[3]. At that time, China has successively established cooperations with more than 30 countries or regions, and China’s cultural relics protection and management concepts have gradually come in line with international standards.

Against this background, on October 28, 2002, the “Protection Law (2002)” was passed at the 30th meeting of the Standing Committee of the Ninth National People’s Congress. For the first time, the law clarifies the sixteen-character guideline for the protection of cultural relics and highlights the importance of research and public awareness. The law supplements the establishment of a licensing system for units engaged in cultural relics protection, systematically improves the protection and management framework for cultural relics, deepens the cognition of “not changing the original state of cultural relics,” and strengthens the operability of existing regulations ^[4].

4.1. Licensing system for units engaged in cultural relics protection

In “The Law of Protection (2002),” for the first time, it is clarified, in the form of legal articles, that units engaged in work related to cultural relics protection in China should have the approval and permission of relevant cultural relics administrative department. In particular, units engaged in repair, relocation, and reconstruction projects must “have obtained the qualification certificate for cultural relics protection projects” and “units engaged in archaeological excavations shall be approved by the cultural relics administrative department of the State Council” ^[5].

4.2. Systematic protection management framework for cultural relics

In Article 3 of “The Law of Protection (2002),” Chinese cultural relics are divided into two categories: immovable cultural relics and movable cultural relics. Concerning immovable cultural relics, the law adds “historical and cultural blocks, villages, and towns,” as evident by Article 14. As of now, the protection and management framework of China’s immovable cultural relics—cultural relics protection units – historical and cultural blocks – historical and cultural cities—has been completed. Concerning movable cultural relics, the law clearly states in Article 3 that “... movable cultural relics are divided into precious cultural relics and general cultural relics; precious cultural relics are divided into first-class cultural relics, second-class cultural relics, and third-class cultural relics” ^[6].

4.3. Deepens the cognition of “not changing the original state of cultural relics”

In “The Law of Protection (2002),” the scope of application of “not changing the original state of cultural relics” has been expanded. This principle is applied not only to the repair, maintenance, migration, and utilization of immovable cultural relics, but also to the restoration, photography, and rubbing of all kinds of cultural relics, as stated in Article 46 of “The Law of Protection (2002).” At the same time, the law also has a more in-depth explanation of the “original state” of immovable cultural relics. This “original state” is

a requirement for protecting not only the cultural relic itself, but also its surrounding environment, as evident by Articles 17, 18, and 19 of “The Law of Protection (2002).”

4.4. Strengthens the operability of regulations

The expanded contents of “The Law of Protection (2002)” is more of a refinement of the existing provisions on the authority, methods of implementation, timeliness, and legal responsibilities. For example, when stipulating how to protect the safety of cultural relics in museum collections, Article 47 of the law states in detail that “museums, libraries, and other units that collect cultural relics,” as competent and responsible institutions, should be equipped with “fire prevention, anti-theft, and other facilities” in accordance with relevant state regulations. As another example, when the law stipulates the relevant measures for the discovery of cultural relics in Article 32, it specifically emphasizes the following: “should rush to the scene within 24 hours,” “suggestions should be raised within seven days,” and other aspects of timeliness.

5. Conclusion

By sorting out and summarizing the changes in the articles of the three laws and regulations, it is clear that the legalization of cultural relics protection in China has gone through a process of improvement from initial establishment to precise improvement, followed by systematic deepening. The provisions of China’s cultural relics protection law have been progressively refined and made more enforceable. Not until recently, the SACH issued “A draft amendment to the Protection of Cultural Relics of the People’s Republic of China (Draft Amendment),” ushering in a new major revision in China’s Cultural Relics Protection Law. The new law will further strengthen the protection of cultural relics, promote the rational and appropriate use of cultural relics, and effectively improve the level of legal management of cultural relics ^[3]. Similarly, the new law will provide a strong backing for the protection and inheritance of the excellent historical and cultural heritage of the Chinese nation.

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References

- [1] Xue L, 2017, An Introduction to the Protection of Architectural Heritage, China Architecture & Building Press, Beijing, 69.
- [2] Xue L, 2017, An Introduction to the Protection of Architectural Heritage, China Architecture & Building Press, Beijing, 79.
- [3] Sun J, 2001, Explanation on the “Law of the People’s Republic of China on the Protection of Cultural Relics (Revised Draft)” – At the 24th Meeting of the Standing Committee of the Ninth National People’s Congress on October 22, 2001, Communiqué of the Standing Committee of the National People’s Congress of the People’s Republic of China.
- [4] Kong Q, 2014, Investigation on the Structure of the Towers and Arches in Beijing, Oriental Press, Beijing, 4.

- [5] Xue L, 2017, An Introduction to the Protection of Architectural Heritage, China Architecture & Building Press, Beijing, 6.
- [6] Ren H, 2008, Comparison of the Similarities and Differences of Three Cultural Relics Laws. Proceedings of the Seminar on Theory and Practice of Museums in Qin, Jin and Henan Provinces, 10.

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The Construction of Foshan Consumption Center City from the Perspective of Cultural and Tourism Integration

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Abstract: Satisfying the rising need for upgraded consumption among residents is not only a vital aspect of consumption, and it also drives the development of cities. The integration of culture and tourism is an important starting point for the construction of consumption center cities. The role of the integration of culture, tourism, and commerce in the construction of consumer-oriented cities is studied in this paper. Foshan's urban consumption environment and the challenges and problems faced in the construction of Foshan's consumption center cities, the path of cultural and tourism integration of consumer resources, consumer space, and consumer environment and consumer brands are analyzed in this paper. Some suggestions on how to promote Foshan consumption center city by integrating culture and tourism are then put forward.

Keywords: Cultural and tourism integration; Consumption center city; Foshan

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1. Introduction

On October 14, 2019, the Ministry of Commerce and 14 other departments jointly issued the “Guiding Opinions on Cultivating and Building International Consumption Center Cities,” which is not only an important measure to meet the increasing consumer demand, but also an effective way to drive the development of cities. The national “14th Five-Year Plan” and the 2035 vision also regard “cultivating international consumption center cities” as an important part of building a strong domestic market and initiating a new development pattern ^[1]. Foshan takes culture and tourism consumption as an important starting point to build a regional consumption center city, and the integration of culture and tourism can better develop emerging consumption hotspots and enhance the power of consumer market and experience value. Therefore, in this paper, the relationship between cultural and tourism integration and consumption center city construction is studied, the problems and challenges of cultural and tourism integration in promoting the construction of Foshan consumption center city is analyzed, and suggestions for promoting the construction of Foshan consumption center city are put forward.

2. The role of cultural and tourism integration in the construction of consumption center cities

With the continuous urbanization of China, urban functions are changing from “production” to “consumption.” The transformation into a “consumption” city can better face the severe challenges of consumption environment, consumption safety, consumption quality and other issues arising in the process of urbanization, enhance the driving force of consumption to drive the economy, and promote industrial

transformation and upgrading ^[2].

The tourism industry has also developed from simple scenic spot tourism to global tourism. Tourism promotes the integration of various departments and industries in different regions, makes full use of regional resources, realizes the coordinated development of tourism economy and the construction of a harmonious society, promotes industrial integration, and forms a new model that drives the integrated development of urban and rural areas ^[3]. "Promoting tourism with business, literature with tourism, and business with culture" can effectively smoothen the flow of people, logistics, capital flow, and information flow, and promote the "optimization of urban commercial system, construction of urban public recreation spaces, and production of urban cultural spaces." Through realizing "cultural tourism of physical commerce and the commercial life of cultural tourism," a new and lasting multi-value network can be built, and the superimposition of "commercial value, recreational value and cultural value" can be achieved, and thus both commercial "flow" and tourist "retention" can be achieved ^[4].

3. Current situation of urban consumption environment in Foshan

3.1. A solid economic foundation and huge potential for consumption

The economy of Foshan is developing steadily and its consumption capacity has increased. In 2021, Foshan's economic aggregate reached 1,215.654-billion-yuan, ranking 17th in China and 3rd in the province. The economy grew by 8.3% annually, which is higher than the national and provincial growth rates, and the industrial added value ranked 5th in the country. Its global free trade "circle of friends" is growing, the import and export volume is growing rapidly, and the foreign trade competitiveness ranks 13th in the country. The total retail sales of consumer goods in the city was 355.666 billion yuan, which was an annual increase of 8.1%, ranking 26th in the country and 4th in the province.

3.2. Abundance of consumer brands and high-end elements

More and more brands are going global. Foshan produces household appliances, home furnishing, building materials, ceramics, food, and many other products. Besides, many top consumer goods manufacturing companies are also situated in Foshan, such as the world's first ceramic and electric fan producer. The city has two Fortune Global 500 companies including Midea and Country Garden, eight China Top 500 companies, and 76 Guangdong Top 500 companies, Hisense, Galanz, Haitian, Jianlibao, and other brands that are sold worldwide.

Foshan permeates into the international consumption circle through exhibition + industry. By organizing exhibitions like Foshan (International) Ceramics and Sanitary Ware Fair, China (Foshan) International Automobile Industry Expo Exhibition, Dragon Furniture Exhibition, and other brand exhibitions, domestic and foreign businessmen will be encouraged to participate in these exhibitions and make procurements.

4. Challenges and problems faced in the construction of Foshan consumption center city through the integration of cultural and tourism industries

4.1. The relationship between industrial cities and tourist cities

As the city progresses into the post-industrial era, backward and heavily polluting industries will be phased out. As a result, the tourism and leisure industry has become a long-term driving force in transforming the city into a service-oriented and quality-oriented direction. Considering that tourism and leisure activities have become part of the normal lifestyle of urban residents, the efficient and reasonable development of the tourism and leisure industry is not only the key to improve the quality of urban development but is also crucial for improving the happiness index of urban residents and the experience value of foreign tourists ^[5]. There is no contradiction between the development of an industrial city and a tourist city. The construction

of consumption center city transformed from traditional consumption center city - production center city - post-industrial consumption center city. Production orientation and consumption orientation are not mutually exclusive in the post-industrial consumption center cities. The mutual promotion of resource endowment accumulation and consumption radiation force will smoothen the consumption and production cycle, improve the trend of consumption, strengthen the construction of independent brands, promote rich cultural and tourism products, create a safe consumption environment, drive the development of urban manufacturing industry, and create and cultivate new growth poles. In addition, the overall attractiveness and competitiveness of the city will also be increased ^[6].

4.2. The neighborhood effect of consumption under the integration of Guangzhou and Foshan

Spatial proximity effect refers to the impact of spatial relation between various economic activities within a region or between different regions on their mutual interactions. It means that populations, enterprises, and communities clustered in adjacent areas can collectively utilize each other's public goods, facilities, and services, thereby promoting economic development. Guangzhou and Foshan have strong industrial complementarity, close spatial proximity, cultural affinity, and intensive personnel exchanges. In April 2021, the "Plan for the Guangzhou-Foshan Integrated Development during the 14th Five-Year Plan Period" was issued, marking a new stage in the comprehensive integration of Guangzhou and Foshan. Due to the convenient transportation network and efficient infrastructure of the two cities, the consumer market has expanded. Foshan's manufacturing industry is well-developed, with a highly competitive market in furniture, appliances, and other consumer goods. There are many commercial districts in Guangzhou like Tianhe Road and Huan Shi Dong, where numerous internationally renowned brands can be found. Guangzhou and Foshan complement each other in terms of consumer structure, making it possible for the two cities to achieve differentiated development by collaborating in the consumer market.

Castells pointed out that in the network society, advanced service systems (including business and productive services) tend to be concentrated in a few metropolitan nodes ^[7]. Under the co-city of Guangzhou and Foshan, a neighboring effect can be achieved, with spatial spillover and siphon effects in mutual consumption. The siphon effect refers to the fact that regions with superior conditions will attract surrounding funds, talent, technology, and other resources, thus delaying the development of surrounding areas ^[8]. Due to its long-term decentralization, Foshan's commercial service system has not been fully developed. Foshan's infrastructure lags behind in terms of attracting and agglomerating consumption, and the city lacks high-end consumer districts reflecting fashion, internationalization, and modernization.

5. Ideas and suggestions for promoting the development of Foshan as a consumption center city through the integration of culture and tourism

In view of the challenges and issues faced in the construction of Foshan as a consumption center city, it is necessary to gather Foshan's cultural, commercial, and tourism resources, leverage the advantages of Foshan's urban manufacturing industry and Lingnan culture, and seize the significant opportunities presented by the Guangdong-Hong Kong-Macao Greater Bay Area, the integration of Guangzhou and Foshan, and the construction of Guangzhou as an international consumption center city. Through the integration of culture, tourism, and commerce, it is important to promote the development of consumer resources, consumer spaces, consumer environments, and consumer brands, and to facilitate the construction of Foshan as a consumption center city.

5.1. Integrating cultural and commercial travel resources to cultivate regional consumption characteristics

It is important to make full use of Foshan's manufacturing industry by transforming the industrial heritage,

industrial process, industrial environment, factory style, and corporate culture into tourism attractions. In this way, tourists will have the opportunity to understand the history, skills, and spirit behind the product. Hence, the integration of culture, business and tourism can be achieved through the operation of commercial resources.

To create “the first city of industrial tourism in China,” it is necessary to make use of Foshan’s advantages in the field of pan-household industry, advanced equipment manufacturing, food and other fields, and design and develop high-quality tourist routes that integrate natural landscape, historical culture, and emerging industrial civilization. Industrial brand enterprises should be encouraged to open exhibition halls to the public, become the highlight of industrial tourism routes, and export corporate brand culture. Vending machines should be installed at scenic spots, hotels, major commercial blocks, industrial tourism route points, Internet-famous places, etc., to sell and promote cultural and creative intellectual property (IP) derivatives and animation merchandise or toys, especially with the idea of creating “China’s first industrial tourism city.”

5.2. Create a consumer business circle and build a cultural tourism consumption cluster

Equipped with ancestral temples, Jihua Road, Guilan Road, and other core business districts as well as distinctive urban clusters, a brand-concentrated group can be created, and distinctively characterized high-quality commercial blocks can be built to form a unique consumption spatial pattern, so as to activate and expand local consumption, attract external consumption, and promote the return flow of mid-to-high-end consumption.

5.2.1. Enhancing the concentration of consumption in core business districts

While considering the layout and planning of commercial facilities, the brands of key business districts should be improved, so as to create large-scale business districts dominated by light luxury and high-end brands. The transformation and upgrading of existing commercial complexes into cultural, commercial, tourism, and sports complexes should be promoted, so as to improve the concentration of consumption, integrate international high-quality brand resources, encourage brand entry to achieve creative localization, and cultivate new consumer patterns and services. Besides, core business districts should include well-known brands, cinemas, compound bookstores, cultural and creative shops, and new amusement performance spaces.

5.2.2. Building exemplary leisure pedestrian street areas to a high standard

The overall commercial quality of Lingnan Tian Di, Creative Industry Park, Qian Deng Lake, and other pedestrian street areas should be improved. The brands of retail stores in the area should be upgraded, and a retail brand system mainly composed of fast fashion brands, high street fashion brands, light luxury, and niche brands should be developed. It is also encouraged to cultivate and develop Foshan’s own brand stores and time-honored stores and create a distinctive brand image for the street area with Lingnan characteristics. The development of new retail formats and mixed-use formats in the blocks that attracts traffic should be encouraged, and child-oriented and leisure and entertainment-oriented business formats should be increased. The structure of the catering industry should be transformed by introducing mid-to-high-end leisure catering and quality restaurants.

5.3. Promoting the deep integration of culture, tourism, and implementing consumer brand projects

The distinctive resources of the five districts in Foshan should be integrated and innovation should be driven by the combination of “culture, tourism, and technology.” Modern information technologies such as the internet and artificial intelligence should be utilized to promote the deep integration of culture, tourism, and

the digital economy. The unique characteristics of Foshan should be integrated, and consumer brand projects should be implemented to enhance the competitiveness of Foshan as a consumption center city.

5.3.1. Home Decor Foshan brand project

Home Decor Foshan consumer project was constructed with Shunde and Chancheng as the core. This project aimed to showcase Foshan's home furnishing culture and creative design through furniture exhibitions and other means. By constructing projects such as China Home Furnishing Expo City and International Home Furnishing Culture Forum, the integration of culture, commerce, and tourism can be promoted to facilitate the development of the Home Decor Foshan brand and establish a home decor cultural industry chain with Foshan characteristics.

5.3.2. Taste Foshan brand project

With the goal of building Foshan and Shunde as the “Capital of Food,” Foshan's culinary history, culture, and various eco-friendly ingredients should be explored. High-quality resources such as culinary techniques should be integrated and a city-wide training system should be established to train “Cantonese cuisine masters.” Moreover, it is important to focus on industry and standard development, promote the deep integration of culture, tourism, commerce, and the “Cantonese cuisine masters,” to showcase Foshan as a culinary destination and develop Foshan's unique culinary path.

5.3.3. Kung Fu Foshan brand project

In line with the development of Foshan as the “World Kung Fu City,” Foshan's rich Kung Fu resources should be explored. Through the deep integration of culture, tourism, and commerce, the value of Kung Fu culture should be promoted, and a Kung Fu cultural industry chain should be established in Foshan. More Kung Fu centers, martial arts industrial parks, and martial arts themed towns, should be built. Besides, distinctive Kung Fu cultural and creative, sports and fitness, and tourism products should be developed. Influential Kung Fu film and television brand events should also be organized, so as to fully integrate digital technology with Kung Fu creativity and stage arts and create new IP for Foshan's Kung Fu performances.

Disclosure statement

The authors declare no conflict of interest.

References

- [1] Xu H, 2022, Research on the Promotion of Tianjin's International Consumer Center City Construction through the Integration of Culture and Tourism. *Journal of Tianjin University of Commerce*, 42(1): 3–14.
- [2] Zhong L, 2013, Discussion on the Creation of an “Appropriate Consumption City”: A Case Study of Foshan City. *Consumption Economics*, 29(5): 72–77.
- [3] Bi D, Tian W, 2021, Integration and Development of “Culture, Commerce, and Tourism” in the Guangdong-Hong Kong-Macao Greater Bay Area under the Background of High-Quality Development: Model Innovation and Optimization Path. *Urban Observation*, 2021(5): 44–51.
- [4] Feng X, Xia J, 2018, Evaluation of the Development Level of China's Comprehensive Tourism and Its Spatial Characteristics. *Economic Geography*, 38(4): 183–192.
- [5] Li W, Chen T, Ma X, 2020, Spatial Hotspot Characteristics and Formation Mechanism of Urban Tourism and Leisure Formats in Xi'an. *Acta Geographica Sinica*, 40(3): 437–446.

- [6] Li C, 2022, Research on the Construction Path of Consumer Center Cities under the New Pattern of “Dual Circulation”: Taking the Synergistic Cities in the Guangdong-Hong Kong-Macao Greater Bay Area as an Example. *Journal of Hubei University of Economics*, 20(1): 28–38.
- [7] Lin G, 2011, Reconstruction of Consumption Space in Metropolitan Areas: A Case Study of Guangfo Integrated Development. *Modern Urban Research*, 2011(6): 15–19.
- [8] Li Z, Huang L, Liao W, 2019, Research on the Development Path of Tourism in Zhenjiang under the Background of Ningzhenyang Integration: Based on the Analysis of Nanjing’s Tourism Siphon Effect. *Journal of Liaoning Higher Vocational College of Communications*, 21(5): 32–36.

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Design of Magnetic Integrated LLC Transformer

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Abstract: The direct current/direct current (DC/DC) converter of the LLC (inductor-inductor-capacitor) converter is an important part of affecting the work efficiency, volume, and weight of the device. It not only has the functions of traditional transformers but is also able to solve the problems of traditional power transformers' high price, huge volume, prodigious no-load loss, and inflexible control. This paper studies the DC/DC converter mainly, according to the given indexes, the magnetic integrated LLC resonant transformer is designed in detail. The magnetic integrated transformer greatly reduces the converter volume, and the selection of devices is completed based on parameters design. In addition, according to design parameters, losses and the efficiency of the LLC resonant transformer are calculated. The results meet the efficiency requirements. A test platform of a full-bridge LLC resonant converter is built according to theoretical research. The correctness and effectiveness of theoretical research and design methods of the DC/DC converter are verified by analyzing the experimental waveforms.

Keywords: DC/DC; LLC resonant converter; Loss analysis; Magnetic integrated transformer

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1. Introduction

The power supply system of the communication equipment room is very complex. To meet the requirements of different voltage levels ^[1], traditional power transformers are currently commonly used for voltage transformation and energy transfer. This type of transformer has a simple manufacturing process and high reliability, but it is costly, large in volume, with severe no-load loss, and inflexible control. Moreover, if there are phenomena such as voltage imbalance, harmonics, flicker, etc., it cannot maintain the normal operation of power equipment ^[2]. It is crucial to ensure electrical equipment provides reliable and stable electricity to users safely ^[3], whereby the direct current/direct current (DC/DC) converter emerged. In addition to possessing the functions of traditional transformers, it also can solve the aforementioned problems. As a new type of transformer, the LLC transformer, which had 2 inductances (L) and a capacitor (C), has become a hot research topic for scholars both domestically and internationally in recent years ^[4-8]. LLC topology, as a dual-ended resonant topology, has been applied in many DC/DC power conversion schemes. This study will design a DC/DC based on the principle of an LLC full bridge DC/DC converter, utilizing the advantages of the LLC resonant converter itself to improve DC/DC efficiency.

2. Working principle of LLC resonant full bridge converter

2.1. Introduction to the circuit structure

The main circuit topology of the LLC resonant full bridge converter is shown in **Figure 1**. During the working process, the excitation inductance L_m may be clamped and not participate in the operation, which determines that the LLC resonant converter will have two different resonant frequencies. When L_m is

clamped, which is generated by the resonant inductance L_r and the resonant capacitor C_r . The expression is:

$$f_r = \frac{1}{2\pi\sqrt{L_r C_r}}$$

When the current flowing through L_r is equal to the current flowing through the resonant inductor L_m , the transformer has no energy transmission, the rectifier tube will be turned off, and L_m will not be clamped by the secondary voltage to participate in resonance. At this time, the resonance frequency is related to the excitation inductance L_m , resonant inductance L_r , and resonant capacitor C_r . The expression is:

$$f_m = \frac{1}{2\pi\sqrt{(L_m + L_r)C_r}}$$

For LLC resonant full bridge converters, they can operate in four operating modes. Assuming the operating frequency is f_s , its relationship with the two resonant frequencies above will determine the range in which the converter operates. The relationship includes four situations: $f_s \leq f_m$, $f_m < f_s < f_r$, $f_s = f_r$, $f_s > f_r$.

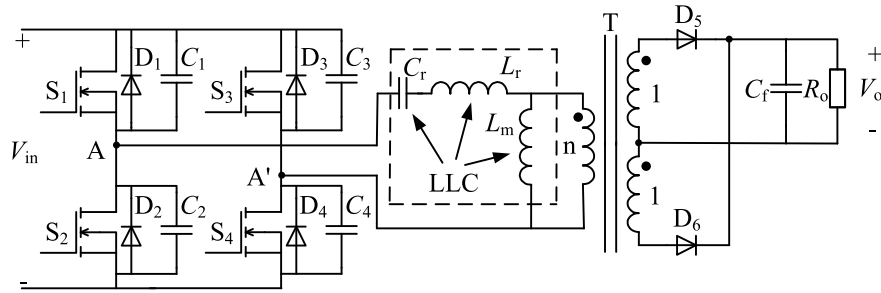


Figure 1. Schematic diagram of LLC full bridge converter

3. Design of LLC full bridge converter

In order to apply to the commonly used voltage levels in communication equipment rooms, the design of LLC resonant converters meets the following design indicators:

- (1) Input voltage range: $V_{in_min} \sim V_{in_max} = 190 \sim 330$ V
- (2) Rated input voltage: $V_{in_nom} = 300$ V
- (3) Expected efficiency, η : $\geq 95\%$
- (4) Output voltage: $V_o = 48$ V
- (5) Ripple voltage: $\Delta V = 240$ mV
- (6) Output current: $I_o = 10$ A
- (7) Resonant frequency: $f_r = 100$ kHz, $k = 6$
- (8) Parasitic capacitance C_{oss} of metal-oxide-semiconductor field-effect transistor (MOSFET): 400 pF
- (9) Equivalent parasitic capacitance C_{stary} of transformer winding and PCB board: 100 pF
- (10) Dead time: 300 ns

3.1. Design of resonant circuit parameters

To meet the input voltage working near f_r at V_{in_nom} , the theoretical transformation ratio m of the transformer can be obtained by using the following equation with the gain $M_{nom} = 1$ at this time, whereas V_F is the conduction voltage drop of the secondary diode, where 1 V is taken.

$$m = \frac{V_{in_nom}}{(V_o + V_F)} = \frac{300}{(48+1)} = 6.12 \text{ V}$$

The minimum gain M_{min} and maximum gain M_{max} of the equivalent circuit are shown here:

$$M_{min} = m \frac{V_o + V_F}{V_{in_max}} = 0.91$$

$$M_{max} = m \frac{V_o + V_F}{V_{in_max}} = 1.58$$

The minimum operating frequency f_{min} and maximum operating frequency f_{max} of the equivalent circuit are as follows:

$$f_{min} = \frac{f_r}{\sqrt{1+k\left(1-\frac{1}{M_{max}^2}\right)}} = 46.64 \text{ kHz}$$

$$f_{max} = \frac{f_r}{\sqrt{1+k\left(1-\frac{1}{M_{min}^2}\right)}} = 156.83 \text{ kHz}$$

Based on the first harmonic approximation (FHA) analysis method, the equivalent load impedance of LLC circuits is as follows, where n is the theoretical transformation ratio of the transformer.

$$R_{ac} = \frac{8n^2 V_o}{\pi^2 I_o} = \frac{8 \times 6.12^2 \times 48}{\pi^2 \times 10} = 145.87 \Omega$$

According to the requirement of maximum gain, the maximum quality factors Q_{max1} and Q_{max2} of the resonant cavity can be obtained through the following equations, where k is the ratio of excitation inductance to resonant inductance, $k = 6$; l_{max} is the maximum normalized frequency.

$$Q_{max1} = \frac{1}{k M_{max}} \sqrt{k + \frac{M_{max}^2}{M_{max}^2 - 1}} = 0.29$$

$$Q_{max2} = \frac{4t_d}{\pi R_{ac} C_{ZVS} (l_{max} - \frac{1}{l_{max}} + k l_{max})} = 0.285$$

Hence, the maximum Q within the entire working range is $Q_{ZVS} = 0.95 \times \min\{Q_{max1}, Q_{max2}\} = 0.27$, where ZVS is defined as zero voltage switching. According to the resonance characteristics, the resonance parameters can be obtained as follows:

$$C_r = \frac{1}{2\pi f_r Q n^2 R_{ac}} = 40.03 \text{ nF}$$

$$L_r = \frac{QR_{ac}}{2\pi f_r} = 62.72 \mu\text{H}$$

$$L_m = kL_r = 376.32 \mu\text{H}$$

According to the conditions for achieving ZVS with the original side switch, the excitation current can be calculated as:

$$I_m = \frac{V_{in,max}}{4f_{max}(L_m + L_r)} = 1.20 \text{ A}$$

The charging current of parasitic capacitors is:

$$I_p = C_{ZVS} \frac{V_{in,max}}{t_d} = 0.98 \text{ A}$$

Since $I_m > I_p$ meets the conditions for achieving ZVS in the primary side switch, the design is considered reasonable.

3.2. Design of magnetic integrated transformer

Integrated LLC resonant converter integrates the resonant inductance and excitation inductance into the transformer for utilizing the leakage inductance and excitation inductance of the transformer fully. Using the magnetic integration approach to integrate LLC resonant converters precisely utilizes the parasitic parameters of the transformer, where using the leakage inductance of the transformer as L_r and the excitation inductance of the transformer as L_m . This converts unfavorable factors into favorable conditions without adding two additional inductors, greatly reducing the volume of the converter. Area product (AP) method^[11] is used to determine the type of transformer magnetic core, which is shown in the following equation:

$$AP = A_e A_w = \left[\frac{P_T \times 10^4}{K_o K_f K_j f_s B_w} \right]^{1.14}$$

In the above formula, A_e is the effective cross-sectional area of the magnetic core; A_w is the window area of the coil; P_T is the apparent power of the transformer, which varies with the circuit. In this paper, the secondary side of the transformer adopts a central tap structure, so $P_T = P_o(1/\eta + \sqrt{2})$, unit W; K_o is the window utilization coefficient, taken as $K_o = 0.3$; K_f is the waveform coefficient, which is 4 for the square wave. K_j is the current density, where $K_j = 400/\text{cm}^2$; B_w is the working magnetic flux density, $B_w = 0.15 \text{ T}$. Bringing the data into the above equation yields can get:

$$AP = \left[\frac{480 \times (\frac{1}{0.95} + \sqrt{2}) \times 10^4}{0.3 \times 4 \times 40 \times 100,000 \times 0.15} \right]^{1.14} = 1.76 \text{ cm}^4$$

ETD39 from TDK Electronics is used as a magnetic core, hence $AP = 3.2125 \text{ cm}^4$, $A_e = 1.25 \text{ cm}^2$, $A_w = 2.57 \text{ cm}^2$, and $\Delta B = 0.3 \text{ T}$. By adding the secondary leakage inductance to the primary inductance, the actual transformation ratio n of the transformer can be obtained using the following equation:

$$n = m \sqrt{\frac{k+1}{k}} = 6.61$$

According to the law of electromagnetic induction, the number of secondary turns can be obtained as:

$$N_s = \frac{V_o + V_F}{2f_{\min} \Delta B A_e} = 14.01$$

Hence, the roundup secondary turn count is 14 turns. According to the transformer ratio, the number of primary turns can be calculated as $N_p = nN_s = 92.59$, giving the roundup primary turn count of 92 turns.

Considering the influence of the skin effect, 64 strands of enameled wire ($\Phi = 0.11$ mm) are wound in parallel on the primary side, whereas the secondary side is made of 63 strands of enameled wire ($\Phi = 0.2$ mm). It not only meets the current stress but also reduces the loss caused by the skin effect.

In order to maximize the leakage inductance of the transformer and meet the requirements of the resonant inductance L_r , it is necessary to reduce the coupling degree of the primary and secondary sides. A combination of slot skeleton and retaining wall can be used to meet the requirements.

3.3. Selection of MOSFET and rectifier diodes

In a full bridge converter, the maximum voltage borne by MOSFET is the maximum input DC voltage, which is the peak value of MOSFET voltage, hence $V_{ds_max} = V_{in_max} = 326$ V. The peak value of MOSFET current is $I_{ds_max} = \sqrt{2} I_{p_RMS} = 3.17$ A. According to 1.5 times the withstand voltage value and 2 times the current value, the CoolMOS-IPW65R041CFD designed by Infineon was selected, with a withstand voltage of 650 V and a maximum conduction resistance of only 41 m Ω .

Rectifier diodes need to achieve zero current switching (ZCS) in high-frequency environments, which is difficult for ordinary diodes. Therefore, it is necessary to choose a fast recovery diode, which can withstand a maximum reverse voltage of 2 times the output voltage, where $V_D = 2V_o = 96$ V. Maximum value of current flowing through the diode is $I_{D_max} = \sqrt{2} I_{s_RMS} = 11.1$ A.

Considering a certain margin, MUR2020 was ultimately selected as the output rectifier diode, with a maximum withstand voltage of 200 V and a maximum average current that can withstand 20 A, $V_F = 1.0$ V.

3.4. Output capacitor design

From the topology and working principle of the full bridge LLC resonant converter, it can be seen that its output only requires capacitor filtering, and the capacitor value is closely related to the output voltage ripple. When the expected ripple $\Delta V \leq 240$ mV, the output capacitance is determined as follows, where ΔV is the expected ripple value, and T_{s_max} is the period corresponding to the maximum switching cycle.

$$C_o = \frac{I_o T_{s_max}}{\Delta V} = 890 \mu F$$

In order to minimize the loss on the capacitor as much as possible, a capacitor with low ESR is selected. Nippon Chemi-Con 1000 μF electrolytic capacitor with low ESR is selected, where the withstand voltage value is 63 V and ESR is 19 m Ω . The actual ripple value is $\Delta V_2 = I_{c_rms} R_{esr} = 0.092$ V, where I_{c_rms} is the effective value of the current flowing through the capacitor, which can be obtained by the following equation:

$$I_{c_rms} = \sqrt{\frac{\pi^2 - 8}{8}} I_o$$

Therefore, the ripple of the output voltage meets the expected requirements.

3.5. Loss and efficiency calculation

3.5.1. MOSFET loss calculation

Due to the use of soft switching technology in this design, the switching loss of the circuit system is zero, and the loss of the MOSFET is only its conduction loss, which is $P_{cond,MOSFET} = I_{d,rms}^2 R_{on} D = 0.1$ W. The R_{on} is the maximum resistance of MOSFET (41 mΩ), $I_{d,rms}$ is the effective value of the current passing through MOSFET (2.24A), and D is the duty cycle of 0.5.

3.5.2. Diode loss calculation

The average current passing through the diode $I_{d,avg} = I_o = 10$ A, and the effective current is $I_{d,rms} = 7.85$ A. If the forward conduction voltage drop V_F of the selected diode is 1.0V, the conduction loss is $P_{cond,diode} = I_{d,rms} V_F [1 - (d/2)] = 5.8$ W. Peak value of diode reverse recovery current $I_{Rmax} = 10$ μA. The reverse bias voltage $V_{Rmax} = 140$ V, and the time from zero to peak reverse current is approximately equal to the time from peak reverse current to positive recovery current, which is $t_{rr1} = t_{rr2} = 35$ ns. The shutdown loss is $P_{sw,diode} = 0.5 V_F I_{Rmax} t_{rr1} f_s + 0.25 V_{Rmax} I_{Rmax} t_{rr2} f_s = 1.24 \times 10^{-6}$ W. Therefore, the total loss of the diode is $P_{diode} = P_{cond,diode} + P_{sw,diode} \approx 5.8$ W.

3.5.3. Transformer loss calculation

The effective values of the primary and secondary currents are $I_{p_RMS} = 2.24$ A, $I_{s_RMS} = 7.85$ A. The copper loss of a transformer $P_{cu,trans} = R_{cu1} I_{p_RMS}^2 + R_{cu2} I_{s_RMS}^2 = [2\sigma j N_1 I_{p_RMS} \sqrt{(\pi A_{e1})}] + [2\sigma j N_2 I_{s_RMS} \sqrt{(\pi A_{e2})}] = 12.4$ W. The magnetic core loss of the transformer $P_{core,trans} = \eta f_{eq}^{\beta} B_{peak}^{\beta} V_e = 1.1$ W. Therefore, the total loss of the transformer $P_{trans} = P_{cu,trans} + P_{core,trans} \approx 12.4$ W + 1.1 W = 13.5 W.

3.5.4. System efficiency calculation

The total loss of the converter is $P_{loss} = P_{MOSFET} + P_{diode} + P_{trans} = 19.4$ W, while the efficiency $\eta = P_o / (P_o + P_{loss}) \times 100\% = 96.12\%$. It can be seen that the efficiency of the system throughout the entire process has reached the required quantity value, indicating that device selection and data selection are reasonable.

4. Experiment validation

Full bridge LLC resonant converter to DC/DC has been built. DC/DC parameters are: (1) The input AC voltage of the input link is 220V (±5%V), the input filtering inductance is 8mH, the rated output DC voltage is 300V, and the output filtering capacitance is 1100 μF; (2) The intermediate link DC/DC converter outputs a given reference voltage of DC 48V and a filtering capacitor of 890 μF; and (3) The output link outputs a power frequency three-phase line voltage of 50V, a power of 460W, a filtering inductance of 0.4mH, a filtering capacitor of 32 μF, and a three-phase pure resistive load.

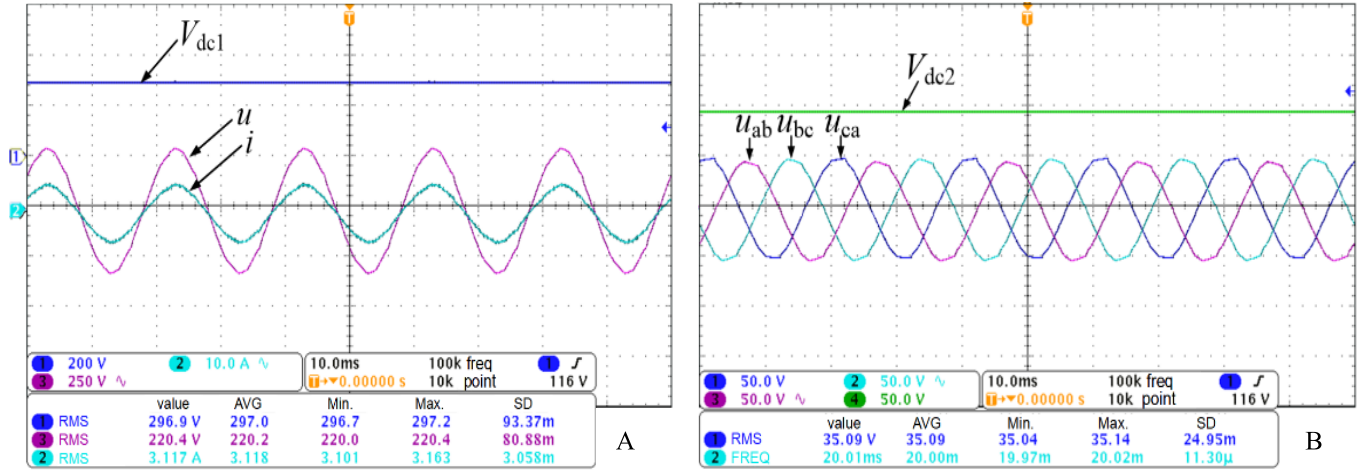


Figure 2. The experimental waveform of LLC in $f_s > f_r$. (A) The input voltage and current, and the output voltage of the input link. (B) The output voltage of the DC/DC converter and the three-phase voltage of the load.

u , i , and V_{dc1} in **Figure 2A** represent the input voltage and current of the input link, as well as the output DC voltage. For the convenience of comparison, the current waveform here has been expanded by 5 times; V_{dc2} , u_{ab} , u_{bc} , and u_{ca} in **Figure 2B** are the DC voltage and load three-phase voltage output by DC/DC converter respectively. From the simulation results, it can be seen that the 220 V AC voltage is input, and after passing through the LLC converter, DC 48 V is output, and finally, a three-phase sinusoidal AC voltage is output through a three-phase inverter circuit. It can be seen that applying a full bridge LLC resonant converter to DC/DC can achieve basic voltage transformation and energy output functions.

Figure 3 shows the output ripple voltage waveform of the DC/DC converter under full load. As shown in the figure, the output ripple voltage value is less than 200mV, which meets the ripple value range set during design.

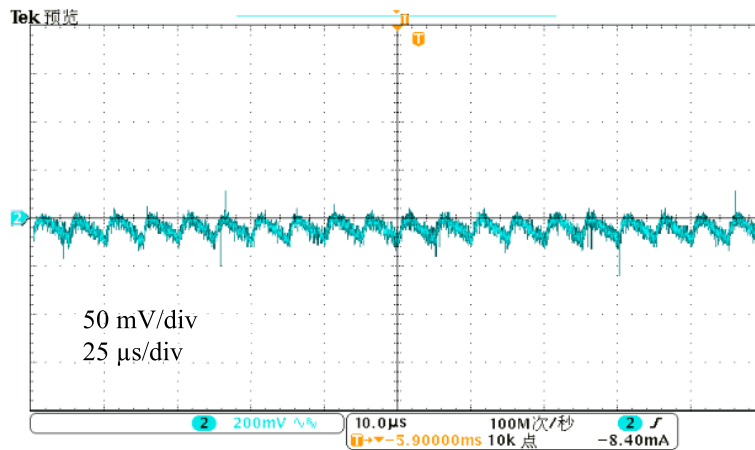


Figure 3. Output ripple voltage under full load

Figure 4 shows the efficiency curves of the experimental device under different conditions. From **Figure 4A**, it can be seen that under full load conditions, the efficiency will also increase with the increase of input voltage. However, when the input voltage exceeds the rated input voltage, the efficiency will decrease. This is because the operating frequency will be greater than the resonant frequency, $f_s > f_r$ when the input voltage exceeds the rated input voltage, which will affect the ZCS realization of the rectifier diode.

From **Figure 4B**, it can be seen that under the rated input voltage, the efficiency continues to improve as the output current increases. When the rated output current is reached, the efficiency is highest. Efficiency exceeds 93% in all conditions. It can be seen that the designed DC/DC converter meets the design requirements.

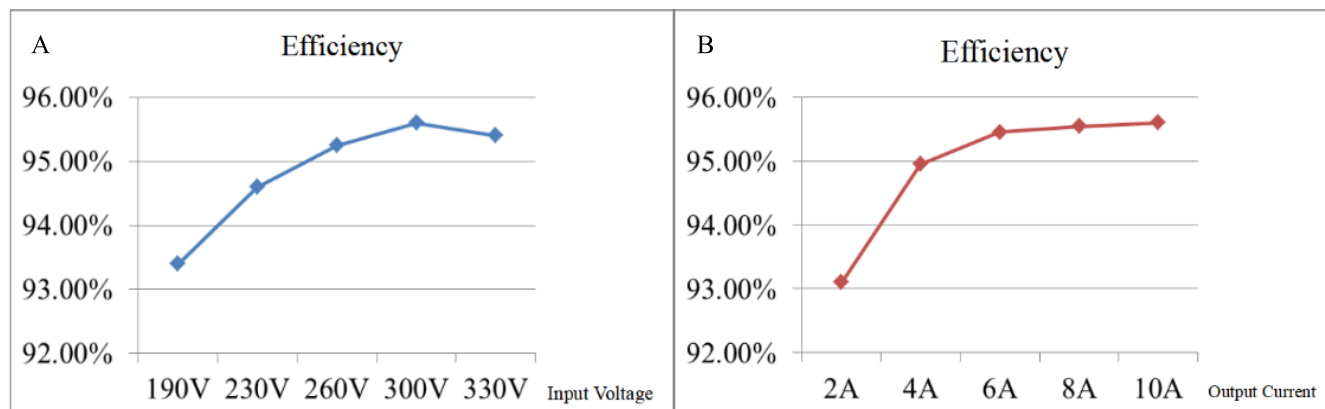


Figure 4. Converter efficiency curve. (A) An output current of 10 A load with different input voltages. (B) An input voltage of 300 V with different output currents.

5. Conclusion

This article studies the working principle of the LLC resonant full bridge converter, analyzes its operation under optimal conditions, determines the main parameters of the converter, and applies soft switching technology to the DC/DC converter to improve efficiency. The correctness and effectiveness of the theoretical research and design methods of DC/DC converters were verified through prototype experiments.

Disclosure statement

The authors declare no conflict of interest

References

- [1] Yoshida D, Kifune H, Hanaka Y, (eds) 2001, IEEE Conference Proceedings Power Electronics and Device Systems, October 25, 2001: ZCS High Frequency Inverter for Induction Heating with Quasi-Constant Frequency Power Control. IEEE, 755–759.
- [2] Sabahi M, Hosseini SH, Sharifian MB, et al., 2010, Zero-voltage Switching Bi-Directional Power Electronic Transformer. IET Power Electr, 5(3): 818–828. <http://doi.org/10.1049/iet-pel.2008.0070>
- [3] Roasto I, Romero-Cadaval E, Martins J, (eds) 2012, Proceedings of IECON 2012-38th Annual Conference on Industrial Electronics Society, October 25–28, 2012: State of the Art of Active Power Electronic Transformers for Smart Grids. IEEE, 5241–5246.
- [4] Posada CJ, Ramirez JM, 2014, Multi-Fed Power Electronic Transformer for Use in Modern Distribution systems. IEEE T Smart Grid, 5(3): 1532–1541. <http://doi.org/10.1109/TSG.2013.2293479>
- [5] Zhao TF, Wang GY, Bhattacharya S, et al., 2013, Voltage and Power Balance Control for a Cascaded H-Bridge Converter-Based Solid-State Transformer. IEEE T Power Electr, 28(4): 1523–1532. <http://doi.org/10.1109/TPEL.2012.2216549>
- [6] Sun G, Gou RF, Sun W, 2016, Research on the Topological Structure and Control Strategy of Power Electronic Transformers Based on MMC Structure. High Volt Electr Appliances, 52(1): 142–147.

- [7] Wang Ting, 2015, Research on Power Electronic Transformers Based on Modular Multilevel Matrix Converters, thesis, Shandong University.
- [8] Mollov SV, Theodoris M, Forsyth AJ, 2004, High Frequency Voltage-Fed Inverter with Phase-Shift Control for Induction Heating. IEE P Electric Power Appl, 151(1): 12–18. <http://doi.org/10.1049/ip-epa:20031058>

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Research on the Hedging Relationship Between the Main Economic Indicators of China and RCEP Member States

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Abstract: In recent years, the bilateral economic and trade relations between China and other Regional Comprehensive Economic Partnership (RCEP) members have developed rapidly, laying a realistic foundation for economic interdependence. In order to comprehensively examine the mechanism of the interdependence of major economic indicators between China and RCEP member states, this paper uses the GAM model to select three main economic indicators of GDP, inflation, and exchange rate, and discusses the economic hedging relationship between China and RCEP member states. The study found that the economic hedging relationship between China and RCEP member states is mainly affected by trade volume, economic scale, and national strength.

Keywords: RCEP; Economy hedge; GDP; Inflation; Exchange rate

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1. Introduction

In November 2020, China, Japan, South Korea, Australia, New Zealand and ten Association of Southeast Asian Nations (ASEAN) countries signed the largest free trade agreement in the world - the Regional Comprehensive Economic Partnership Agreement (RCEP). The economic ties between RCEP member states and China has been very close and growing closer in the 40 years since China's reform and opening up^[1]. According to the United Nations Commodity Trade Database (UNCTAD), in 2021, the total bilateral trade between China and RCEP member states will reach US\$1,867.4 billion, of which China's exports to RCEP member states will reach US\$875.1 billion and imports will reach US\$992.3 billion. With ASEAN surpassing the European Union to become China's largest trading partner, RCEP has undoubtedly become the regional economic organization that has the greatest influence on China.

Many scholars have conducted research on the economic hedging effect between countries, which can be divided into two categories according to the positive and negative effects of national economic shocks. Regarding the study of positive shocks, Bagnai^[2] used the global macro-econometric model to examine the impact of a series of shocks on the Chinese economy on the rebalancing of global savings and demand. Arora and Vamvakidis^[3] explored the short-term and long-term effects of China's economic growth on the economic growth of the rest of the world based on vector autoregressive and error correction models. Wang and Liu^[4] studied the impact of China's economy on the world economy based on the panel individual fixed effect model. Research shows that China's economy has had a significant impact on the development of the world economy in both trade and direct investment.

2. Analysis model

2.1. Model building

Generalized additive models (GAMs) extend generalized linear models (GLMs) by replacing linear predictors with smooth functions of a set of explanatory variables^[5]. In a GAM model, the response variable Y can follow any distribution of the exponential family, and the link function g can Y convert the response variable to a scale that is linear to the model. For the response variable Y , GAM can be expressed as follows:

$$g(E(Y)) = \alpha + \sum_{j=1}^p f_j(X_j) \quad (1)$$

where f_j is j the smooth function of $g(.)$ explanatory variable, α is the intercept, and X_j is the monotonic link function. By fitting smooth functions, GAM is more flexible than GLM because it allows non-linear relationships between the response variable and each explanatory variable. Smooth functions in GAMs are usually estimated by a spline defined by a curve consisting of piecewise polynomial functions connected at points called knots.

2.2. Variable selection

Gross domestic product (GDP) is a measure of the size of a country or region's economy. When China is economically hedged with other countries, GDP can reflect the size of trade and the intensity of economic activity between the two countries. The inflation rate is a measure of the economic health of a country or region. If a country has a higher inflation rate than another, it is likely to be at a trade disadvantage. The exchange rate is a measure of the exchange rate index of a country or region's currency against other countries' currencies. When China hedges its economy with other countries, the exchange rate affects the trade and investment relationship between the two countries.

Based on formula (1), China's GDP, CPI, and EX were selected as the response variables in turn, and the economic indicators corresponding to the RCEP member states, the import and export trade volume (Trade) between the two countries, and the global economic development level were selected. The Brent crude oil price index (CFD) was used as an explanatory variable, and the GAM model was used to study the hedging effect of the economic indicators of the RCEP member states on China. Thirdly, the GDP, CPI, and EX of the RCEP member states were selected as the response variables in turn, and the corresponding economic indicators of China, the import and export trade volume between the two countries, and the Brent crude oil price index (CFD) as an explanatory variable, where the GAM model was used to study the hedging effect of China on the main economic indicators of RCEP member states. The data from the first quarter of 2000 to the fourth quarter of 2021 were selected as samples, and all quarterly data came from the EIC database.

3. Empirical analysis

First, the GAM model is used to study the hedging effect of China on the main economic indicators of RCEP member states. The regression results are shown in **Table 1**.

Table 1 shows the F value of each explanatory variable. This value can judge the importance of each influencing factor on the response variable. The larger the value, the more important the factor. "****" represents the significance of < 0.01 , "***" represents the significance of < 0.05 , and "**" represents the significance < 0.1 . The country codes of RCEP member states are as follows: Australia (AU), Cambodia (KH), Indonesia (ID), Japan (JPN), New Zealand (NZ), Singapore (SG), South Korea (KR), Thailand (THA), Vietnam (VIE), Philippines (PH), Laos (LA), Malaysia (MAS), Myanmar (MM), Brunei (BN).

Table 1. The regression results of China's hedging effect on the main economic indicators of RCEP member states

	GDP			CPI			EX		
	GDP	Trade	CFD	CPI	Trade	CFD	EX	Trade	CFD
AU	0.84	1.27	6.39***	59.56***	5.725***	3.315*	20.37***	15.61***	3.27**
KH	14.54***	1.14	5.48***	28.25***	3.02***	0.03	0.46	6.15***	1.41
ID	5.07***	5.95**	8.70***	85.25***	6.38***	2.02*	1.83*	10.09***	1.31
JPN	8.07***	2.21*	2.60**	70.46***	1.25	3.52***	13.17***	7.85***	2.23*
NZ	3.32***	7.89***	7.93***	20.40***	3.03**	10.82***	4.76***	16.53***	0.00
SG	29.27***	5.72***	2.39	27.48***	2.07	1.88	3.75***	5.62***	3.60***
KR	25.60***	40.11***	9.48***	69.24***	3.58***	13.82***	21.11***	5.63**	1.43
THA	3.42***	0.80	2.60**	31.47***	4.90***	8.72***	1.40	2.08*	4.37***
VIE	1.45	0.21	9.00***	98.34***	2.46**	2.68**	0.73	3.23**	31.16***
PH	16.85***	1.38	1.35	37.44***	5.36***	6.70***	6.93***	2.89**	4.54***
LA	23.41***	6.59***	7.08***	31.31***	16.35***	3.80*	2.06**	2.84**	5.53***
MAS	5.89***	1.42	8.62***	74.32***	3.84***	2.32	9.87***	12.00***	1.75
MM	1.35	3.10**	0.09	33.04***	7.54***	0.98	0.01	0.36	0.06
BN	3.64***	19.93***	0.75	21.67***	0.50	6.16***	3.02**	31.29***	3.70**

Next, the GAM model is used to study the hedging effects of RCEP member states on China's main economic indicators. The regression results are shown in **Table 2**.

Table 2. Regression results of RCEP member states' hedging effects on China's main economic indicators

	GDP			CPI			EX		
	GDP	Trade	CFD	CPI	Trade	CFD	EX	Trade	CFD
AU	0.02	9.30***	6.64***	71.79***	6.15***	3.40***	15.55***	2.47*	8.94***
KH	20.61***	1.52	1.31	32.77***	2.47*	0.93	0.21	0.02	2.77**
ID	4.60***	24.30***	3.19*	23.45***	7.86***	2.17*	5.85***	0.18	1.54
JPN	5.15***	35.88***	1.88	64.98***	7.96***	1.19	27.72***	1.37	1.51
NZ	4.12***	6.88***	24.77***	23.26***	3.23***	3.48***	8.58***	1.89	10.90***
SG	97.05***	20.24***	6.60***	22.15***	35.49***	8.76***	5.75***	0.02	2.96*
KR	13.21***	23.65***	18.12***	99.20***	2.63**	1.53	10.88***	2.98*	4.74***
THA	4.03***	9.51***	8.38***	13.87***	7.63***	2.88**	1.28	0.54	0.43
VIE	6.51***	1.48	7.42***	77.73***	2.34**	1.57	4.41***	0.42	2.50**
PH	27.03***	3.50*	2.98**	29.83***	6.78***	2.34	5.86***	8.17***	3.55***
LA	75.85***	10.73***	21.01***	35.61***	1.23	0.54	4.43***	4.58***	5.38***
MAS	7.63***	69.31***	1.80	71.08***	5.90***	10.39***	8.27***	3.04**	2.87**
MM	4.56***	0.71	3.39*	54.93***	5.39***	1.49	2.12*	2.26	2.43*
BN	0.80	8.83***	7.94***	6.30***	10.60***	3.08***	6.16***	1.80	3.94***

As shown in **Table 2**, China's main economic indicators have an impact on the corresponding economic indicators of most RCEP member states. Specifically, except for Australia, Vietnam, and Myanmar, China's GDP is significant to the GDP of the other RCEP member states at the 1% level, which indicates that China's economic development has a positive effect on the RCEP member states. Among

them, Singapore and South Korea are the most impacted. There are many funds from China in Singapore's investment field, and these funds have promoted Singapore's economic development. Due to its geographical proximity, China is one of South Korea's important trading partners, and South Korea exports a huge amount of goods and services to China.

From the perspective of exchange rates, compared with ASEAN countries, the hedging relationship between China and the more developed countries in the RCEP member states is more significant. This difference is mainly caused by the economic size and strength of the country. Japan, South Korea, Australia, and other countries have strong economies and trade scale, and their trade and investment relations with China have had an important impact on the RMB exchange rate and the exchange rate of their own currencies. When a country's exchange rate increases, the country's exports become more expensive, thus limiting the exports, while imports become cheaper, resulting in an increase in imports. This can lead to trade deficits in other countries, negatively affecting the economies of other countries.

4. Conclusion

RCEP is the largest free trade agreement between China and its surrounding areas, and its member states have close economic ties with China. The GAM model was applied in this paper, with three main economic indicators of GDP, inflation, and exchange rate, and the economic hedging relationship between China and the RCEP member states was explained. It was found that the development of China's economy boosted the RCEP members states to a certain extent and had the greatest impact on Singapore and South Korea. Except for Australia and Brunei, the GDP of RCEP member states had a significant impact on China's GDP. The hedging effect of the CPI index between China and RCEP member states was related to the bilateral trade volume. Compared with ASEAN countries, the hedging relationship between China and the more developed countries in the RCEP member states was more significant, and the economic size and strength of the countries led to the existence of this difference. According to the results of this research, the following conclusions are obtained:

- (1) Strengthening transnational cooperation among RCEP member states
With the deepening of the implementation of the RCEP agreement, governments and enterprises of RCEP member states need to actively promote transnational cooperation in order to make full use of the complementary advantages between countries and achieve mutual benefit and win-win results.
- (2) Promoting regional trade diversification
As the uncertainty of the global economy increases, countries need to strengthen trade diversification to reduce dependence on a single market. RCEP member states should carry out economic and trade activities according to local conditions, industrial structure, and comparative advantages of each country. By expanding the scope of the trade market and reducing excessive dependence on the trade volume of a certain country or region, trade risks are reduced.
- (3) Pay attention to risk management
RCEP member states should always pay attention to potential risks brought by other countries in the region, such as trade disputes, technological competition, and geopolitical risks. Actively respond to these risks to ensure the stability and security of economic cooperation relations.

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Disclosure statement

The authors declare no conflict of interest.

References

- [1] Zhang Y, 2020, RCEP Regional Value Chain Reconstruction and China's Policy Choices—Based on the “Belt and Road” Construction. *Asia Pacific Economy*, 2020(5): 14–24 + 149.
- [2] Bagnai A, 2009, The role of China in Global External Imbalances: Some Further Evidence. *China Economic Review*, 20(3): 508–526.
- [3] Arora V, Vamvakidis A, 2011, China's Economic Growth: International Spillovers. *China & World Economy*, 19(5): 31–46.
- [4] Wang X, Liu C, 2018, The Spillover Effect of China's Economic Growth - Are Trade and Investment Channels Important?. *Economics and Management Research*, 39(03): 16–25.
- [5] Huang X, Shao T, Zhao J, et al., 2020, Analysis of Influencing Factors of O₃ Concentration in Xi'an City Based on GAM Model. *Environmental Science*, 41(04): 1535–1543.

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Research on the Classroom Teaching of Engineering Mechanics in Vocational Colleges

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Abstract: The Engineering Mechanics course has great significance in vocational education as it affects the quality of subsequent specialized courses, such as mechanical design, control technology, and automation. However, the teaching quality of Engineering Mechanics in vocational colleges has been subpar due to the extensive knowledge points, abstract concepts, complex formulas, and other factors. This paper aims to elucidate the early-stage research conducted by scholars and analyze the primary issues in the teaching of Engineering Mechanics. Furthermore, we provide five concrete suggestions to improve the teaching quality of this course. The findings of this study may serve as a reference for innovating the teaching model of Engineering Mechanics in vocational colleges.

Keywords: Teaching; Engineering mechanics; Vocational colleges; Vocational education

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1. Introduction

Engineering Mechanics is a compulsory basic course for mechanical, electrical, and rail transportation majors. Its knowledge system is relatively comprehensive, involving many branches such as statics, dynamics, and mechanics of materials ^[1]. This course contains a wide range of content and many abstract concepts and complex formulas. Students in vocational colleges generally find Engineering Mechanics difficult to learn. On one hand, it is because the solution of practice problems requires many calculations, which is their weakness ^[2]. On the other hand, students lack practical experience and do not understand the dynamics of mechanical equipment, which makes them unaware of the importance of Engineering Mechanics, so quality of Engineering Mechanics teaching in vocational colleges remains poor ^[3,4]. In this paper, we studied the innovation of Engineering Mechanics teaching with the aim of improving its teaching quality. We provided some targeted suggestions based on an in-depth analysis of the problems in teaching. The findings of this paper can provide reference for the classroom teaching reform of front-line teachers.

2. Research status

Many scholars have conducted early-stage research on the teaching of Engineering Mechanics. Yue ^[5] integrated professional knowledge into classroom teaching and observed that this approach sparked curiosity among students. Jiao ^[6] incorporated cutting-edge testing techniques into classroom teaching and discovered that this enhanced students' comprehensive skills and innovation abilities. Zhao ^[7] conducted a teaching experiment in which Engineering Mechanics was oriented towards professional certification. The results showed that this model clarified the learning objectives and improved classroom teaching efficiency.

Chen ^[8] proposed a hybrid teaching mode that is combining online and offline teaching, in which he believed provided more convenience for students and met their diverse needs. Zhu ^[9] analyzed the problems in classroom teaching and recommended an engineering capability-oriented teaching method that achieved positive results in practice. Su ^[10] discussed the need for teaching reform in Engineering Mechanics from a talent training perspective and proposed effective measures to cultivate students' problem-solving abilities.

3. Challenges faced

Engineering Mechanics is a professional technical foundation course that focuses on both theory and practice. The traditional teaching mode has certain drawbacks that does not allow students to fully master this course. Therefore, teachers must pay attention to these drawbacks and actively carry out teaching innovation, strive to improve teaching quality, and lay a good foundation for their students' future learning.

3.1. Disconnection between theory and practice

The traditional method of teaching Engineering Mechanics focuses on theoretical knowledge, but ignores the cultivation of practical ability. It is difficult for students to combine theoretical knowledge with practical engineering applications, which leads to weak practical ability of students. The teaching of Engineering Mechanics courses in some vocational colleges lacks opportunities for students to improve their practical skills, and students just listen to lectures and watch videos in the classroom. This means that students' theoretical knowledge is disconnected from practical operations, which in turn lead to their weak practical and hands-on ability, and it will be a hidden danger when students look for jobs in the future.

3.2. Outdated teaching materials

The teaching materials used in some vocational colleges are outdated. The content of these teaching materials is mostly theoretical, and the content lacks variety and is disconnected from practical engineering applications. Many graduates stated that, "after I started working and saw the mechanical components on the production line, I realized that this is what we learned in our books." This shows that too much emphasis is placed on theoretical knowledge and the content is not well-connected to what is practiced in the industry. With the development of science and technology, the field of Engineering Mechanics is also progressing and developing, so it is necessary to update the teaching materials to reflect the latest research and technological development in order to strengthen the training of students' comprehensive quality.

3.3. Single teaching method

The traditional teaching method of Engineering Mechanics course is mainly theoretical, focusing on explaining the formula and derivation process. This teaching mode easily leads to students' lack of practical ability and difficulty in mastering the practical application of Engineering Mechanics knowledge. Modern teaching methods focus more on practical skills and experiments and encourage student participation. To improve the teaching quality, teachers should teach theoretical knowledge and allow their students to operate different equipment at the same time and combine the two organically.

3.4. Insufficient cultivation of innovation ability

Some vocational institutions only focus on the theoretical knowledge in the teaching of Engineering Mechanics but neglect the cultivation of students' innovation ability and comprehensive quality. As a result, students will only focus on using formulas to perform different calculations, but lack understanding of the actual production process, which in turn is not conducive to the students' ability to innovate in practical operations. The cultivation of innovative ability is not important enterprise jobs, but also an important ability that vocational college students should master.

3.5. Poor course evaluation mechanism

The evaluation mechanism of Engineering Mechanics course is relatively simple, which is mostly based on examination results. This assessment mode lacks a comprehensive evaluation of students' comprehensive ability, and it is difficult to effectively evaluate students' learning effect and practical ability. Since the usual classroom performance has nothing to do with the final grade, students will not pay attention to classroom lectures and ignore the learning process. In order to cope with exams, some students study in a blitz a few days before the exam. In this case, even if they manage to get good grades, the knowledge will be easily forgotten and their foundation will be weak, which will affect their future development.

4. Targeted suggestions

In view of the problems faced in teaching Engineering Mechanics, we have put forward several suggestions to improve the effectiveness of classroom teaching.

4.1. Strengthening the basic knowledge

Engineering Mechanics is a basic course in engineering disciplines, which requires students to have solid knowledge of mathematics and physics. Therefore, teachers need to emphasize the importance of basic knowledge in their lessons to help students establish a solid theoretical foundation. Many of the concepts in Engineering Mechanics are abstract, and students face difficulties in understanding and integrating the theoretical knowledge in the textbook. Therefore, teachers should make models with real objects and explain the concepts through concrete examples. Besides, teachers can help students understand the practical application of Engineering Mechanics through case studies. These cases can be actual engineering problems or derived from major engineering projects to help students better understand the principles of Engineering Mechanics and motivate them to learn.

4.2. Emphasizing practical applications

Practicality has been increasingly emphasized in Engineering Mechanics, which is the connection between theoretical knowledge and practical application. In teaching, teachers can prompt students to think and explore through case studies, experiments and simulations to help students understand the connection between theoretical knowledge and practical engineering applications and enhance their application ability and innovation abilities. When teachers teach Engineering Mechanics, the focus should be on practical applications. Teachers can provide many examples of practical problems for students to learn how to apply the principles to actual engineering problems and perform simulation experiments to make students understand the principles and laws more thoroughly and improve the effect of classroom teaching.

4.3. Strengthening the calculation ability

Engineering Mechanics is a course that requires a lot of calculations, and students often cannot obtain the correct results due to careless mistakes, so teachers need to strengthen students' calculation ability. Teachers can guide students to master the calculation methods and techniques, while focusing on the rationality and accuracy of the calculation results. When explaining the Engineering Mechanics course, students should be provided with some targeted exercises to help them master various calculation skills and methods of analyzing problems.

4.4. Diversified teaching methods

The methods of teaching Engineering Mechanics should be diversified, including lectures, discussions, case studies, experiments, and other ways. Through different teaching methods, teachers can meet the learning needs of different students and improve the teaching effect. Engineering Mechanics is a difficult course.

Therefore, teachers need to pay attention to students' learning progress and identify and solve the problems they face in time. Teachers should always consider their students' feelings, set up targeted questions for important and difficult points in the textbook, answer their students' questions, and encourage them to think and draw conclusions, thus mobilizing their learning enthusiasm. Teachers should also teach some new technologies related to mechanics, such as computer modeling and digital analysis, to help students understand the principles of Engineering Mechanics more deeply. With the continuous development of digital technology, the teaching of Engineering Mechanics courses in vocational colleges and universities has also been gradually digitalized. Teachers can use multimedia courseware, network resources, and videos to teach and improve the effect of classroom teaching.

4.5. Focusing on the cultivation of innovation ability

Modern Engineering Mechanics course teaching has begun to emphasize more on the cultivation of students' practical ability and innovation ability. The talent cultivation methods of Engineering Mechanics course should be diversified. For example, teachers can let students master the related knowledge and skills by carrying out innovative projects and participating in competitions. Moreover, teachers should also cultivate students' innovation consciousness and entrepreneurial ability through project-based teaching and practical courses to lay a solid foundation for their future career development. With the development of economy, the teaching of Engineering Mechanics in vocational colleges and universities has been increasingly emphasizing on the cooperation with enterprises. Higher vocational colleges and universities should establish an industry-university-research collaborative platform to cultivate students' practical and application skills through projects and training bases to improve their employment competitiveness and innovation skills.

5. Results

In this article, we analyzed the problems existing in the teaching of Engineering Mechanics in vocational colleges based on previous studies. Furthermore, we have put forward some targeted suggestions, such as focusing on the cultivation of innovative ability, diversifying teaching methods, enhancing computing ability, emphasizing practical applications, and strengthening basic knowledge. It is crucial for vocational colleges to continue to explore and adopt innovative teaching methods that align with the needs and characteristics of their students to improve the quality of Engineering Mechanics teaching. With these innovative methods, students can better understand the complex concepts of Engineering Mechanics, enhance their problem-solving skills, and ultimately become more competitive in the job market. The findings of this paper can serve as a valuable reference for vocational colleges seeking to enhance their Engineering Mechanics teaching quality through innovative approaches.

6. Conclusion

The trends of teaching reform of Engineering Mechanics courses in vocational colleges and universities are diversification, practicability and innovation. These trends will help improve students' learning effectiveness and practical ability, and better meet the needs and development requirements of society. The problems in the teaching of Engineering Mechanics courses in vocational colleges are multifaceted. Therefore, teachers should make efforts to improve and innovate teaching methods, especially on the combination of theory and practice. Engineering Mechanics is a very practical subject, and its content is closely related to engineering. Hence, students' practical and innovative abilities should be emphasized to better adapt to the needs of enterprise positions and personal career development.

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Disclosure statement

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Author contributions

M.L conceived the idea of the study and wrote the first draft. J.M revised the format of the article.

References

- [1] Deliktas B, 2011, Computer Technology for Enhancing Teaching and Learning Modules of Engineering Mechanics. *Computer Applications in Engineering Education*, 19(3): 421–432. <https://doi.org/10.1002/cae.20321>
- [2] Wang S, 2022, Current Situation and Teaching Exploration of Engineering Mechanics in Vocational Colleges. *Scientific and Social Research*, 4(3): 6–12. <https://doi.org/10.26689/ssr.v4i3.3695>
- [3] Wang S, Ma J, Zhen X, 2022, Teaching Reform of Engineering Mechanics in Higher Vocational Colleges. *Journal of Contemporary Educational Research*, 6(4): 16–23. <https://doi.org/10.26689/jcer.v6i4.3795>
- [4] Collier BD, Scott MJ, 2009, Effectiveness of Using a Video Game to Teach a Course in Mechanical Engineering. *Computers & Education*, 53(3): 900–912. <https://doi.org/10.1016/j.compedu.2009.05.012>
- [5] Yue JF, Zheng LP, Li JJ, 2022, Teaching Design of Engineering Mechanics for Polymer Specialty. *Chinese Polymer Bulletin*, 2022(4): 74–78. <https://doi.org/10.14028/j.cnki.1003-3726.2022.04.009>
- [6] Jiao ZH, Cui ZL, Yuan QP, 2022, Application of SHPB Testing Technology in Mechanics Experimental Teaching of Mining Engineering. *Experimental Technology and Management*, 39(3): 205–208. <https://doi.org/10.16791/j.cnki.sjg.2022.03.037>
- [7] Zhao J, Gu JF, Zhang CY, 2020, Teaching Reform of Engineering Mechanics Based on Engineering Education Professional Certification. *Journal of Luoyang Institute of Science and Technology*, 30(2): 94–96. <https://doi.org/10.3969/j.issn.1674-5043.2020.02.020>
- [8] Chen L, 2022, Application of Hybrid Teaching Based on Superstar Learning in Engineering Mechanics Class. *Journal of Yunnan Open University*, 24(1): 50–54. <https://doi.org/10.3969/j.issn.2095-6266.2022.01.008>
- [9] Zhu Q, Ji P, Chen H, 2022, Research on the Courses Teaching of Engineering Mechanics Under the Background of New Engineering. *Popular Science & Technology*, 24(4): 154–156 + 163. <https://doi.org/10.3969/j.issn.1008-1151.2022.04.040>
- [10] Su M, Xiong CJ, Zhang TL, 2020, Teaching Reform of Engineering Mechanics in View of Engineering Certification. *Shandong Chemical Industry*, 49(3): 111–112. <https://doi.org/10.3969/j.issn.1008-021X.2020.03.049>

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Research on Finite Element Technology in the Development of Mechanics Course Resources

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Abstract: Mechanics course in vocational colleges faces challenges such as a lack of physical equipment, insufficient hands-on experience, difficulty in visualizing abstract concepts, and cost and safety concerns associated with physical experiments. This paper explores the application of finite element technology (FET) in overcoming these challenges and improving mechanics course teaching in vocational colleges. FET is a simulation-based method that can provide extensive hands-on experience, enhance visualization of abstract concepts, and offer a cost-effective and safe learning environment. The effectiveness of FET-based mechanics education has been demonstrated in numerous studies, and the outlook for FET-based mechanics education in vocational colleges is promising.

Keywords: Mechanics course; Vocational college; Finite element technology; Teaching; FET

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1. Introduction

Vocational education plays a vital role in supporting the economy and supplying talents for industries and enterprises. Therefore, it is crucial to continuously innovate the teaching methods of vocational education to ensure that they are up-to-date and relevant. Innovations in teaching models for vocational college courses require active exploration and experimentation. Mechanics is a crucial and rapidly evolving field that plays a vital role in various industries ^[1,2]. Mechanics courses are essential in the education of mechanical engineering students, providing them with a solid foundation in theoretical knowledge and practical skills. However, there are significant challenges in teaching mechanics courses in vocational colleges, including the lack of physical equipment, insufficient hands-on experience, difficulty in visualizing abstract concepts, and cost and safety concerns associated with physical experiments ^[3,4]. These challenges can hinder students' understanding of mechanical principles and their ability to apply theoretical knowledge practically. Finite element technology (FET) is an excellent example of an innovative teaching model that can potentially revolutionize mechanics course teaching in vocational colleges ^[5,6]. By providing a simulation-based approach to learning, FET can enhance students' understanding of abstract concepts.

2. Research status

Research in mechanics education has explored various aspects, including instructional strategies, curriculum design, and the integration of technology in teaching. Yue ^[7] integrated professional knowledge into classroom teaching, which sparked curiosity among students. Jiao ^[8] incorporated cutting-edge testing techniques into classroom teaching, which enhanced students' comprehensive skills and innovation abilities. Zhao ^[9] conducted a teaching experiment in which Engineering Mechanics was oriented towards

professional certification, which resulted in clarifying the learning objectives and improving the efficiency of classroom teaching. Chen ^[10] proposed a hybrid teaching model that combined online and offline methods, which made learning more convenient. Zhu ^[11] analyzed the problems in classroom teaching and recommended a capability-oriented teaching method for engineering courses that achieved positive results in practice. Su ^[12] discussed the need for teaching method reform in Engineering Mechanics from a talent training perspective and proposed effective measures to cultivate students' problem-solving abilities. While these approaches have their merits, there are still challenges in terms of providing practical experiences, visualizing abstract concepts, and managing costs and safety concerns. In recent years, there has been a growing interest in the application of FET in mechanics courses. This technology offers a computer-based approach to simulate mechanical systems and analyze their behavior, providing students with a virtual platform to explore complex mechanical phenomena, visualize abstract concepts, and conduct experiments in a safe and cost-effective manner. FET-based mechanics courses has been shown to enhance students' understanding of mechanical principles, improve their problem-solving abilities, and equip them with practical skills, which are qualities that are highly valued in the industry ^[5,6]. However, the extent of its application and its impact on mechanics courses in vocational colleges are still under research. Further research is needed to refine and improve FET-based mechanics courses and provide comprehensive training to educators.

Overall, the application of innovative teaching models like FET in mechanics education has the potential to revolutionize vocational education and supply talents for the industry ^[13,14].

3. Problems faced in mechanics courses

There are several problems in the teaching of mechanics courses in vocational colleges, including the lack of physical equipment, insufficient hands-on experience, difficulty in visualizing abstract concepts, and cost and safety concerns associated with physical experiments.

3.1. Lack of hardware equipment

The lack of physical equipment is a significant challenge in mechanics course teaching in vocational colleges. Due to budget constraints and limited resources, many vocational colleges struggle to provide students with access to sophisticated equipment and tools. This limitation restricts students' ability to perform physical experiments and gain practical experience, thus hindering their understanding of mechanical principles.

3.2. Insufficient hands-on experience

Traditional mechanics education relies heavily on physical experiments to provide students with hands-on experience. However, due to constraints such as limited time and resources, students often have insufficient opportunities to engage in practical learning. This lack of hands-on experience hinders their ability to apply theoretical knowledge to real-world scenarios effectively.

3.3. Difficulty in visualizing abstract concepts

Mechanical principles often involve abstract concepts that can be challenging for students to visualize and comprehend. Students may struggle to grasp complex mechanical phenomena, such as stress distribution, deformation patterns, and failure modes, solely through theoretical explanations and equations. This difficulty in visualizing abstract concepts impedes students' understanding and hampers their ability to apply theoretical knowledge practically.

3.4. Cost and safety concerns

Physical experiments in mechanics courses can be costly and potentially hazardous. Setting up experiments, procuring equipment, and ensuring safety measures require significant financial resources and careful management. Moreover, student safety during physical experiments is a critical concern. The high costs and safety risks associated with physical experiments often limit the scope and depth of hands-on learning experiences.

4. Advantages of applying FET to mechanics course teaching

FET has emerged as a promising tool in mechanics course teaching in vocational colleges. By simulating mechanical phenomena and processes, FET can overcome many of the outstanding problems faced by traditional mechanics education, such as the lack of physical equipment, insufficient hands-on experience, difficulty in visualizing abstract concepts, and cost and safety concerns.

4.1. Overcoming hardware limitations

FET can overcome the limitations of physical equipment in mechanics course teaching. By using simulation software, students can perform experiments on virtual models that accurately simulate real-world scenarios. This capability enables students to explore a wide range of mechanical phenomena and processes that may not be feasible with limited physical equipment, thus enhancing their understanding of mechanical principles.

4.2. Enhancing practical learning

FET provides students with extensive hands-on experience in mechanics course teaching. Through simulation exercises, students can apply theoretical knowledge to real-world scenarios and gain practical skills that are highly valued in the industry. FET also allows students to perform experiments repeatedly and explore various design options, which enhances their problem-solving and critical thinking abilities.

4.3. Visualizing abstract concepts

FET enables students to visualize and comprehend abstract mechanical concepts effectively. Simulation software can generate high-quality visualizations that illustrate complex mechanical phenomena, such as stress distribution, deformation patterns, and failure modes. This function enhances students' understanding of mechanical principles and facilitates their ability to apply theoretical knowledge practically.

4.4. Cost and safety effectiveness

FET is a cost-effective and safe alternative to physical experiments in teaching mechanics courses. By using simulation software, students can perform experiments without the need for expensive equipment, hence reducing the overall cost of mechanics education. Moreover, simulation exercises eliminate the safety risks associated with physical experiments, ensuring that students can learn in a safe and controlled environment. Overall, the application of FET in mechanics courses in vocational colleges offers significant advantages over traditional mechanics education. By overcoming the problems faced in traditional mechanics education, FET can enhance students' understanding of mechanical principles, equip them with practical skills that are highly valued in the industry, and provide a cost-effective and safe learning environment.

5. Results and outlook

Numerous studies have been carried out on the effectiveness of FET in mechanics course teaching in vocational colleges, and the results are promising. Students who received FET-based mechanics education demonstrated superior performance in understanding mechanical principles and applying theoretical

knowledge practically. Moreover, students expressed high levels of satisfaction with FET-based mechanics education, citing the enhanced hands-on experience, improved visualization of abstract concepts, and cost and safety effectiveness as key benefits.

The outlook for FET-based mechanics education in vocational colleges is bright. The widespread availability of simulation software and the increasing demand for practical skills in the industry make FET-based mechanics education a valuable asset for vocational colleges. Further research is needed to refine simulation techniques, improve access to simulation software, and provide comprehensive training to educators.

6. Conclusions

FET has emerged as a powerful tool in mechanics course teaching in vocational colleges, offering a viable solution to the outstanding problems faced by traditional mechanics education. By simulating mechanical phenomena and processes, FET can overcome the limitations of physical equipment, provide extensive hands-on experience, enhance visualization of abstract concepts, and offer a cost-effective and safe learning environment. The effectiveness of FET-based mechanics education has been demonstrated in numerous studies, and the outlook for FET-based mechanics education in vocational colleges is promising. However, further research is needed to refine and improve FET-based mechanics education, and to provide comprehensive training to educators.

In conclusion, the application of FET in mechanics course teaching in vocational colleges is a valuable asset that can enhance students' understanding of mechanical principles, equip them with practical skills that are highly valued in the industry, and provide a cost-effective and safe learning environment.

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Author contributions

J.M and S.W. conceived the idea of the study and wrote the first draft of the paper. W.H. revised the format of the article.

References

- [1] Wang S, 2019, Significance, Characteristics and Implementation Measures of the Implementation Plan of National Vocational Education Reform. *Journal of Shijiazhuang Vocational and Technical College*, 31(3): 4–10. <https://doi.org/10.3969/j.issn.1009-4873.2019.03.002>
- [2] Wang S, Peng F, Li M, 2022, Enhancing the Problem-Solving Skills of Vocational Students through Skills Competition. *Journal of Contemporary Educational Research*, 6(12): 9–15. <https://doi.org/10.26689/jcer.v6i12.4546>
- [3] Deliktas B, 2011, Computer Technology for Enhancing Teaching and Learning Modules of Engineering Mechanics. *Computer Applications in Engineering Education*, 19(3): 421–432.

<https://doi.org/10.1002/cae.20321>

- [4] Wang S, 2022, The Current Situation and Teaching Exploration of Engineering Mechanics in Vocational Colleges. *Scientific and Social Research*, 4(3): 6–12. <https://doi.org/10.26689/ssr.v4i3.3695>
- [5] Wang S, Wang X, Peng F, 2023, Teaching Practice of Engineering Mechanics Based on Finite Element Method. *Proceedings of IEEE 12th International Conference on Educational and Information Technology (ICEIT)*, 262–267. <https://doi.org/10.1109/ICEIT57125.2023.10107893>
- [6] Wang S, Wang X, Peng F, 2023, Teaching Practice of Engineering Mechanics Based on Finite Element Analysis. *Proceedings of 11th International Conference on Information and Education Technology (ICIET)*, 103–108. <https://doi.org/10.1109/ICIET56899.2023.10111408>
- [7] Yue JF, Zheng LP, Li JJ, 2022, Discussion on Teaching Design of Engineering Mechanics for Polymer Specialty. *Chinese Polymer Bulletin*, 2022(4): 74–78. <https://doi.org/10.14028/j.cnki.1003-3726.2022.04.009>
- [8] Jiao ZH, Cui ZL, Yuan QP, 2022, Application of SHPB Testing Technology in Mechanics Experimental Teaching of Mining Engineering. *Experimental Technology and Management*, 39(3): 205–208. <https://doi.org/10.16791/j.cnki.sjg.2022.03.037>
- [9] Zhao J, Gu JF, Zhang CY, 2020, Teaching Reform of Engineering Mechanics Based on Engineering Education Professional Certification. *Journal of Luoyang Institute of Science and Technology*, 30(2): 94–96. <https://doi.org/10.3969/j.issn.1674-5043.2020.02.020>
- [10] Chen L, 2022, Application of Hybrid Teaching based on Superstar Learning in Engineering Mechanics Class. *Journal of Yunnan Open University*, 24(1): 50–54. <https://doi.org/10.3969/j.issn.2095-6266.2022.01.008>
- [11] Zhu Q, Ji P, Chen H, 2022, Research on the Courses Teaching of Engineering Mechanics under the Background of New Engineering. *Popular Science & Technology*, 24(4): 154–156 + 163. <https://doi.org/10.3969/j.issn.1008-1151.2022.04.040>
- [12] Su M, Xiong CJ, Zhang TL, 2020, Teaching Method Reform of Engineering Mechanics under the Background of Engineering Certification. *Shandong Chemical Industry*, 49(3): 111–112. <https://doi.org/10.3969/j.issn.1008-021X.2020.03.049>
- [13] Wang S, Peng F, Zhen X, 2023, Finite Element Modeling and Simulation of Torsion Experiment and Teaching Practice in Vocational Colleges. *Proceedings of the 2023 14th International Conference on E-Education, E-Business, E-Management and E-Learning*, 82–86. <https://doi.org/10.1145/3588243.3588280>
- [14] Wang S, Zhu Q, Zhen X, 2022, Application of Modeling and Simulation Technology in Teaching Practice of Engineering Mechanics. *Proceedings of the 2022 5th International Conference on Education Technology Management*, 110–116. <https://doi.org/10.1145/3582580.3582598>

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[1] Yao Y., Xia B. Application of Phase Frequency Feature Group Delay Algorithm in Database Differential Access. *Computer Simulation*, 2014, 31(12): 238-241.

Journal article (print) with more than three authors

[2] Gamelin F.X., Baquet G., Berthoin S., et al. Effect of high intensity intermittent training on heart rate variability in prepubescent children. *European Journal of Applied Physiology*, 2009, 105: 731–738.

Journal article (online) with one to three authors

[3] Jackson D., Firtko A., Edenborough M. Personal resilience as a strategy for surviving and thriving in the face of workplace adversity: a literature review. *Journal of Advanced Nursing*, 2009, 60(1): 1–9,

Journal article (online) with more than three authors

[4] Hargreave M., Jensen A., Nielsen T.S.S., et al. Maternal use of fertility drugs and risk of cancer in children—A nationwide population-based cohort study in Denmark. *International Journal of Cancer*, 2015, 136(8): 1931–1939.

Book

Book with one to three authors

[5] Schneider Z., Whitehead D., Elliott D. Nursing and midwifery research: methods and appraisal for evidence-based practice. 3rd edn. 2009, Elsevier Australia, Marrickville, NSW.

Book with more than three authors

[6] Davis M., Charles L., Curry M.J., et al. Challenging spatial norms. 2013, Routledge, London.

Chapter or Article in Book

[7] Knowles M.S. Independent study. In Using learning contracts. 1986, Jossey-Bass, San Francisco, 89–96.

Others

Proceedings of meetings and symposiums, conference papers

[8] Chang S.S., Liaw L. and Ruppenhofer J. (eds). Proceedings of the twenty-fifth annual meeting of the Berkeley Linguistics Society, February 12–15, 1999: general session and parasession on loan word phenomena. 2000, Berkeley Linguistics Society, Berkeley.

Conference proceedings (from electronic database)

[9] Bukowski R.M. Prognostic factors for survival in metastatic renal cell carcinoma: update 2008. Innovations and challenges in renal cancer: proceedings of the third Cambridge conference. Cancer, 2009, 115 (10): 2273, viewed 19 May 2009, Academic OneFile database.

Online Document with author names

[10] Este J., Warren C., Connor L., et al. Life in the clickstream: the future of journalism, Media Entertainment and Arts Alliance, 2008. viewed 27 May 2009, http://www.alliance.org.au/documents/foj_report_final.pdf

Online Document without author name

[11] Developing an argument n.d., viewed March 30 2009, http://web.princeton.edu/sites/writing/Writing_Center/WCWritingResources.htm

Thesis/Dissertation

[12] Gale L. The relationship between leadership and employee empowerment for successful total quality management. 2000, University of Western Sydney.

Standard

[13] Standards Australia Online. Glass in buildings: selection and installation. AS 1288–2006. 2006, SAI Global database.

Government Report

[14] National Commission of Audit. Report to the Commonwealth Government, Australian Government Publishing Service, 1996, Canberra.

Government report (online)

[15] Department of Health and Ageing. Ageing and aged care in Australia, 2008, viewed 10 November 2008, <http://www.health.gov.au/internet/main/publishing.nsf/Content/ageing>

No author

[16] Guide to agricultural meteorological practices. 2nd edn, Secretariat of the World Meteorological Organization, 2010, Geneva.

Note: When referencing an entry from a dictionary or an encyclopedia with no author there is no requirement to include the source in the reference list. In these cases, only cite the title and year of the source in-text. For an authored dictionary/encyclopedia, treat the source as an authored book.

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As part of the submission process, authors are required to check off their submission's compliance with all of the following items, and submissions may be returned to authors that do not adhere to these guidelines.

1. The submission has not been previously published, nor is it before another journal for consideration (or an explanation has been provided in Comments to the Editor).
2. The submission file is in OpenOffice, Microsoft Word, RTF, or WordPerfect document file format.
3. Where available, URLs for the references have been provided.
4. The text is single-spaced; uses a 12-point font; employs italics, rather than underlining (except with URL addresses); and all illustrations, figures, and tables are placed within the text at the appropriate points, rather than at the end.
5. The text adheres to the stylistic and bibliographic requirements outlined in the Author Guidelines, which is found in About the Journal.
6. If submitting to a peer-reviewed section of the journal, the instructions in Ensuring a Blind Review have been followed.



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Cooperation Mode



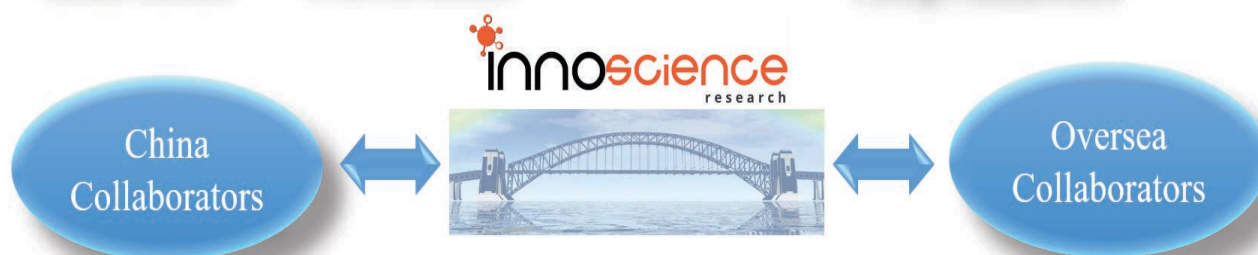
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