Applying Factor Analysis to Assess Employment Competitiveness Strategies: A Data Science Perspective

Yang Wang[1], Thosporn Sangsawang[2,*], Piyanan Pannim Vipahasna[3], Kitipoom Vipahasna[4], Wasan Watkraw[5]

[1]*Vocational Education Division, Faculty of Technical Education, Rajamangala University of Technology Thanyaburi, Thailand*

[2,3,4,5]*Educational Technology and Communications Division, Faculty of Technical Education, Rajamangala University of Technology Thanyaburi, Thailand*

Abstract

This study aims to identify and analyze the factors influencing the employment competitiveness of graduates from higher vocational colleges in China and evaluate the impact of targeted programs designed to enhance these factors on graduates' employability. The research involved 17 experts and 100 instructors from Sichuan University of Science and Engineering, utilizing purposive sampling to explore effective career guidance models for improving employment ability. The Delphi technique was applied to synthesize expert opinions on key factors affecting graduate employment competitiveness. Additionally, a sample of undergraduate students participated in the study, with data collected through questionnaires. The findings demonstrate the transformative potential of focused career guidance programs, showing a significant improvement in students' employability post-intervention. These results emphasize the importance of targeted initiatives that equip students with the necessary skills, resources, and career insights to succeed in the job market. By bridging the gap between academia and industry expectations, such programs play a crucial role in preparing students for a smooth transition from university to the professional world, helping them secure meaningful employment opportunities.

Keywords: Factors Impacting Employment Competitiveness, Career Guidance, Model, Employment Ability, Higher Vocational Colleges, China

1. Introduction

Vocational education plays a critical role in bridging the skills gap between traditional academic systems and labor market demands by equipping students with technical and soft skills essential for employment. In China's rapidly evolving economy, advanced vocational education services are increasingly prioritized to address mismatches between formal education and workforce needs. Vocational institutes must rigorously analyze factors influencing employability—such as technical proficiency and interpersonal competencies—to enhance graduates' career prospects. However, achieving this requires systematic evaluation of these factors.

Parallel to this, career planning education has gained prominence as a tool for societal development, addressing the needs of individuals, families, and governments. UNESCO's 1974 Recommendation on Technical and Vocational Education emphasized lifelong learning and career guidance as foundational educational components [1], [2]. This framework empowers individuals to make informed decisions about their education and career trajectories, thereby boosting employability and societal participation [3]. Integrating career guidance into technical and vocational education and training (TVET) systems has proven effective in preparing graduates for workforce entry, particularly through collaborations between educational institutions, employers, and governments [4]. These initiatives not only advance individual career development but also align with broader societal objectives, such as economic growth, social equity [5], and sustainable development [6]. Ultimately, a robust career planning education system benefits individuals, families, and communities while supporting governmental goals for inclusive and sustainable progress. The shift to a socialist market economy in China has significantly heightened awareness of career planning education among students nationwide. This transition has been coupled with policies like the "Six Promises," which elevates the employment of

college graduates to utmost importance, highlighting the government's commitment to enhancing guidance and support systems for students [7]. Xi Jinping has emphasized education's critical role in developing a powerful nation and cultivating committed socialists equipped with comprehensive skills, signaling the significance of employing college graduates in nurturing talent and sustaining socialism. According to the 20th National Congress, employment is the primary means of subsistence, impacting family welfare, social stability, economic growth, and educational returns.

Research indicates that students with higher career expectations engage more actively in career planning, influenced by their perceptions of the labor market [8]. This supports findings that stress the importance of integrating career education into academic curricula, which helps bridge the gap between students' career choices and labor market demands [9]. The Chinese government has actively implemented regulations to enhance college graduate employment opportunities. In 2011, the "Opinions on Further Enhancing Employment and Entrepreneurship Opportunities for University Graduates" provided job training recommendations, encouraged graduate entrepreneurship, and broadened employment prospects. In 2015, the Ministry of Education, alongside nine other agencies, published "Opinions on Strengthening Graduate Employment" with the aim of redesigning graduate employment strategies, improving services, encouraging entrepreneurship, and enhancing government aid. College students were encouraged to introduce adaptable entrepreneurial support policies. In 2016, the "State Council Notice" further promoted innovative service systems, and the "Notice on Graduate Employment and Entrepreneurship" from 2020 proposed job training, support for entrepreneurs, and expanded public welfare programs to combat the COVID-19 epidemic. These efforts aim to improve the employment and entrepreneurial ecosystem for college students, encouraging active labor market participation and securing employment.

Career development courses have shown to enhance students' career awareness and planning abilities, indicating that structured educational interventions are vital for preparing graduates for an evolving job market [9]. As China continues navigating its economic transition, integrating comprehensive career planning education becomes crucial not only for individual success but also for meeting broader socio-economic goals [10], [11]. This collective shift in viewpoints, especially since the 1990s, underscores the importance of career advising in boosting student job opportunities and supporting societal development.

Implementing an effective career advising model in higher education is crucial for enhancing graduates' employability and providing comprehensive training, particularly in the context of China's rapid economic growth and reforms in the 1990s, which led to a shift from an elite to a mass education system. This transition has resulted in a significant surge in university graduates, raising concerns about employment since 2003 [12]. By 2020, China is projected to have 8.74 million university graduates, increasing to 11.76 million by 2023, marking the highest growth rate since 2012. Additionally, the Ministry of Education reports a rise in students returning from studying abroad due to the pandemic and shifting international relations. Song Zishuang highlights that career advising can significantly enhance graduates' employability and provide practical training, addressing these challenges.

Research underscores the vital role of institutions in cultivating students' employability by integrating targeted career guidance programs into their curricula [13]. Evidence shows that participation in career development initiatives significantly improves graduates' employment prospects, with studies demonstrating marked increases in employability scores among students engaged in such programs [14]. The complexities of the current labor market necessitate a comprehensive approach to career advising that not only addresses individual needs but also aligns with the evolving demands of the economy [15]. Therefore, enhancing career advising services is essential for preparing graduates to navigate the job market effectively [16]. This holistic approach ensures that graduates are equipped with the skills and knowledge needed to thrive in a competitive and dynamic employment landscape.

One million students will surpass the previous two million in returning from studies abroad by 2021. Their experiences and career goals give them a competitive advantage in the job market. However, they face competition from domestic university graduates to secure employment. The global economy significantly impacts countries like China [17]. An unusual economic slowdown worldwide disrupted businesses and significantly influenced production and living conditions. China's GDP expanded at 3% in Q1 2022, lower than forecast. A 1% GDP decline could lead to job losses. Nationwide urban unemployment was 5.5% between September 2022 and 2023, with 17.9% of 16-24-year-olds

unemployed. Educated individuals face increasing difficulty finding employment due to the decline in labor demand and the simultaneous rise in graduates leading to underemployment and unemployment.

The phenomenon of slow employment where graduates delay pursuing employment or further education in favor of activities such as traveling or teaching, is increasingly prevalent. This behavior is often driven by graduates' careful assessment of their career prospects, focusing on stability, lucrative incomes, and readily available job opportunities [18]. However, many individuals are reluctant to take employment in underdeveloped regions, small businesses, or demanding roles, preferring renowned companies and established metropolitan areas. They prioritize central urban locations and large organizations, often disregarding their personal interests, capabilities, and job prospects, which hinders informed career choices. Some individuals adopt a "passive" approach, deliberately avoiding aggressive job pursuit, further contributing to the trend of slow employment.

In China, rapid economic development and a highly competitive job market have exacerbated this trend, as graduates face significant pressure to secure desirable positions [19]. Research indicates that many graduates experience career decision-making difficulties, which can lead to delays in employment [20]. Factors such as insufficient job opportunities, economic pressures, and traditional family expectations contribute to this phenomenon, compelling graduates to take time off to evaluate their options [21]. Additionally, Chinese university students consistently experience high levels of anxiety during their studies, particularly among recent graduates, which further complicates their transition into the workforce.

The COVID-19 pandemic has intensified these challenges, with many graduates opting for temporary non-employment as they reassess their career paths in light of changing market conditions [22]. Understanding the motivations behind slow employment is crucial for developing effective career advising strategies that can better support graduates in their transition to the workforce. By addressing the underlying factors contributing to slow employment, such as career decision-making difficulties and labor market pressures, institutions and policymakers can help graduates make more informed and confident career choices, ultimately facilitating smoother entry into the workforce.

Anxiety levels rise progressively from the first to the last year of college, with percentages of 8%, 14%, 26%, and 35%, respectively. This correlation between anxiety and self-awareness, as well as high employment ambitions, suggests that undergraduate students should prioritize career planning. Career planning involves making informed choices based on interests, abilities, beliefs, and professional goals to consistently achieve these goals. Early career planning in China should focus on internships and projects to acquire desired skills and information [23].

Addressing practical issues in China's higher education and employment sectors requires collaboration between educational institutions, the government, and corporations. This includes providing career advice and training resources to help graduates choose jobs based on their interests and potential rather than money and location. Career planning and self-perception should also improve to meet job market demands. Fostering self-employment and entrepreneurship enhances graduates' prospects and reduces stress. Graduates should prioritize mental health issues like anxiety, depression, and self-doubt to maintain a positive outlook. This research offers pragmatic guidance and ways to enhance the employment chances of graduates from Chinese vocational colleges. By addressing employability challenges, vocational institutions can improve their teaching programs and align them with industry demands, stimulating national economic development. The research's clear methodology benefits educational institutions, governments, and students by enhancing vocational education and job outcomes. Chinese students in higher vocational institutions demonstrated skill strategies for job competitiveness, with a strong association between positive reactions and skill proficiency.

This study aims to achieve two primary research goals, each addressing critical aspects of employability among graduates from higher vocational colleges in China. The first goal is to systematically identify and analyze the key factors that influence the employment competitiveness of these graduates. These factors may include technical skills, soft skills such as communication and problem-solving, career planning abilities, internship experiences, and alignment with labor market demands. By examining these elements, the study seeks to provide a comprehensive understanding of what makes vocational college graduates competitive in the job market. Additionally, the study will explore how external factors, such as economic conditions, industry trends, and government policies, interact with individual competencies to shape employability outcomes. This analysis will help identify gaps in the current vocational education system and highlight areas for improvement. The second goal of the study is to evaluate the effectiveness of programs

designed to enhance graduates' employability. Specifically, the study will assess the impact of these programs on graduates' skills, career readiness, and employment outcomes before and after their participation. This evaluation will focus on initiatives such as career guidance workshops, internship placements, entrepreneurship training, and industry collaborations. By comparing pre- and post-program data, the study aims to measure the extent to which these initiatives improve graduates' employability and job market performance. The findings will provide evidence-based insights into the strengths and limitations of existing programs, offering actionable recommendations for optimizing their design and implementation. The significance of these research goals extends to multiple stakeholders. For vocational colleges, the study will help refine curricula and training programs to better align with industry needs and enhance graduates' employability. For policymakers, the findings will inform the development of future policies to support vocational education and graduate employment. For graduates, the study will empower them to make informed decisions about their education and career paths by identifying the factors that contribute to employment competitiveness. For employers, the research will provide insights into the skills and competencies of vocational college graduates, facilitating better recruitment and workforce planning.

2. Literature Review

2.1. Related theoretical research

Bloom's Mastery Learning Model, developed in the late 1960s, posits that most students can achieve academic success if they possess a positive attitude, sufficient prior knowledge, and well-structured assignments with clear instructions [7]. Bloom suggests that 80% of students can achieve the required competency with proper support, though only 20% reach this level under regular conditions. The model emphasizes that IQ is not the sole predictor of academic success and highlights the importance of collaborative instruction, personalized learning, frequent feedback, and extended learning time for all students to meet educational goals. It estimates that 90-95% of students can achieve proficiency when teachers effectively address students' needs [24], [25]. This approach underscores the value of tailored educational experiences that cater to individual learning needs, fostering a conducive environment for mastery of content [26].

In the context of career education, the application of mastery learning principles can significantly enhance students' career development competencies. For instance, effective career education programs that incorporate experiential learning and individualized support can improve students' engagement and satisfaction [26]. By integrating structured career planning activities within educational curricula, institutions align with the mastery learning approach, encouraging students to actively assess their career aspirations and develop actionable plans [27]. This structured and supportive framework not only helps students build confidence in their abilities but also equips them with the skills necessary to navigate the complexities of the job market.

Ultimately, adopting a mastery learning framework in career education ensures that students are better prepared for their professional journeys. By addressing individual learning needs and providing consistent feedback and support, institutions can help students achieve both academic and career-related goals, fostering a generation of graduates who are confident, skilled, and ready to succeed in their chosen fields [28].

Piaget's Constructivism theory focuses on how children develop their cognitive abilities through interaction with their environment. This theory, which evolved with contributions from psychologists like Kohlberg, Sternberg, Katz, and Vygotsky, emphasizes that children create and refine cognitive structures by engaging with the world. In the 1980s, constructivism challenged traditional information-processing psychology and emphasized the importance of meta-cognition and knowledge construction. In 2011, Wang Zhuli introduced the New Constructivist Learning Theory, which aims to address the challenges of the digital age, such as information overload and fragmented knowledge. It promotes cooperative learning, problem-solving, and continuous updating of knowledge systems, suggesting a shift towards student-centered teaching and the integration of technology and innovation in curriculum design [29], [30].

2.2. Dependent Variable Research Career Planning Guidance

Old Chinese idioms emphasized work as essential for prosperity and stability, linking employment to social status and wealth. Employment was seen as a means of survival, with specialized labor in various crafts contributing to societal efficiency [31], [32]. In ancient China, job specialization helped people achieve financial security and social prestige,

while in Western civilizations, employment became more complex, requiring specific skills that advanced the economy and society [33]. The concept of career, derived from the Latin word "carrière," refers to a person's lifelong professional development, including all job-related activities, attitudes, and goals [34], [35]. Bloom's Mastery Learning Model suggests that with the right conditions, 80% of students can achieve competency in school, emphasizing the importance of cognitive, emotional, and teaching effectiveness [25]. Piaget's Constructivism Theory explains how children's cognitive development is shaped by interaction with their environment, with learning occurring through coordination and creation of schemas [36].

Career guidance in higher education is crucial for preparing students to meet market demands. Factors influencing employability include education, external factors, curriculum relevance, and economic shifts. Chinese students often face employment-related anxiety due to skill mismatches and high expectations, making it essential for graduates to evaluate their abilities and adjust their expectations. Future research should explore emerging trends such as digital transformation and remote work [37]. Social support plays a significant role in personal development and employability, with some students benefiting from stronger networks, particularly those from wealthier or more influential backgrounds. However, excessive social support can hinder progress, and studies on this issue have shown that the quality of social support can impact employability outcomes [37].

2.3. Research on Different Career Planning Guidance Models

Career guidance is essential in today's job market, with theories like the RIASEC model and Parsons' Trait and Factor Theory providing valuable frameworks. The RIASEC model classifies people into six groups based on their interests: realistic, investigative, artistic, social, enterprising, and conventional. It focuses on matching individuals with careers that align with their interests and personality traits, aiding students in choosing courses and careers that suit them. Tools like the Self-Directed Search help identify fitting jobs, though the rise of technology and remote work challenges traditional notions of a good fit [38].

Parsons' Trait and Factor theory, developed by Frank Parsons in the early 1900s, guides career decisions by matching individuals' characteristics with job requirements. This theory uses a three-step process of self-assessment, understanding occupations, and logical decision-making. While it has been widely used in career counseling, it is critiqued for being overly static and emphasizing rational decision-making. Future research should adapt these models to account for emerging trends and create culturally inclusive approaches [38].

2.4. Delphi Technique

The Delphi Method, introduced in 1953 by Olaf Helmer and Norman Dalkey, is a technique used to obtain consensus from a panel of experts. It involves multiple rounds of questionnaires, where experts revise their responses based on feedback until a consensus is reached. This method is widely used for gathering expert opinions, forecasting trends, and making informed decisions on complex issues. The key features of the Delphi Method include anonymity, repetition, controlled feedback, and statistical aggregation. Anonymity reduces the influence of dominant individuals and encourages honest opinions from experts [39].

The Delphi technique is a valuable tool for group communication and structured problem-solving, particularly when direct meetings are not feasible or when minimizing bias from dominant voices is important. It allows professionals to explore all aspects of an issue through surveys and open-ended questions, drawing on the experiences of experts. This method, which includes Delphi and nominal group procedures, follows strict rules for collecting and evaluating expert opinions, ensuring a systematic approach to decision-making [40]. It is widely used in fields such as business, policy-making, healthcare, and education to identify key issues and causal links in complex social or economic events.

Despite its strengths, the Delphi technique has limitations. It can be time-consuming and is susceptible to expert attrition, which may affect the reliability of the results. The quality of responses heavily depends on the expertise of the selected panel, making the careful selection of participants crucial. Moreover, the lack of face-to-face interactions can sometimes hinder the depth of discussions.

The Delphi technique remains particularly useful for gathering collective expert knowledge and finding consensus when face-to-face interactions are not possible. It has been applied in various domains, such as feasibility studies, urban planning, curriculum development, and policy analysis. In instructional design, the modified Delphi technique gathers

feedback through mail or email, allowing for an iterative process of problem definition, feedback, and revisions to reach expert consensus.

The Delphi method begins with Round One, where experts independently respond to a questionnaire, offering their thoughts, ideas, and forecasts related to the problem at hand. The responses are qualitative and exploratory. The facilitator summarizes these responses and identifies key themes without revealing the identities of the experts. These condensed responses are then shared with the participants in subsequent rounds, allowing them to review and refine their thoughts. The goal of this round is to gather a wide range of ideas from the experts, which will be analyzed and further refined in later stages. In the second round, experts are shown the summarized responses from the first round. They are asked to rate or provide further input on the ideas, offer clarifications, and suggest new approaches. Experts are encouraged to refine their earlier responses, consider the feasibility of the ideas, and brainstorm implementation strategies. This round is aimed at narrowing down the responses to identify which ideas have the most potential for development. It may require several iterations to achieve some level of convergence among the experts. This round helps in further refining ideas and building consensus. The third round focuses on finalizing the expert opinions by prioritizing the ideas based on importance, urgency, or feasibility. Experts are asked to rank or prioritize the concepts presented in the previous rounds. This final round is crucial for reaching an agreement on which ideas are most practical and ready for implementation. The facilitator compiles all the feedback and organizes the ideas based on the group's consensus. The results from this round help in making informed decisions and contribute to policymaking, scenario planning, or further research. The iterative process ensures that all relevant insights are explored, and expert opinions are integrated, leading to a clearer, more informed outcome [41].

3. Research Method

This study focuses on Delphi research conducted by Chinese university professors, examining innovative factors through various methods such as questionnaires, expert discussions, data collection, analysis, and statistics. Both quantitative and qualitative methodologies were employed. The study involved surveying 17 instructional designers about three specific ideas. The research calls for expertise from Chinese academics, including university professors and experts from administrative departments. All participating specialists hold advanced degrees in higher education management, doctorates, have over five years of experience, and are associate professors. The research aims to explore the innovative abilities of Chinese university instructors more thoroughly. Figure 1 illustrates the research method used in this research.
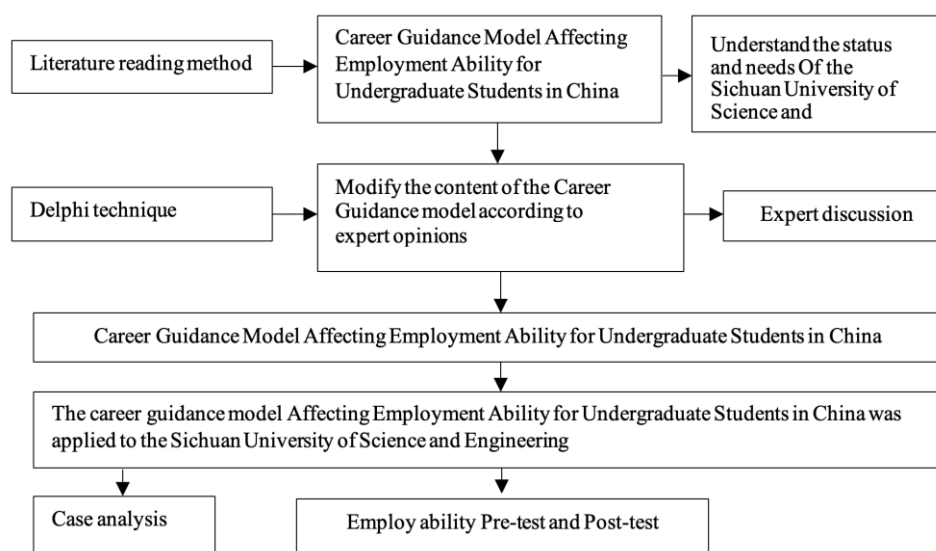

Figure 1. Research Method Flowchart

The first round of brainstorming collects university teachers' creativity influence variables, including individual, organizational, and familial aspects. It produces a questionnaire. The second round evaluates university instructors' innovation abilities in China using a five-point Likert scale. Experts assign scores to indicators and evaluation criteria

to assess their importance and relevance. The third round adds new items to the questionnaire and estimates their relevance. Based on this, it creates questionnaire II. Questionnaire III combines university professors' innovative factors into a final questionnaire. It asks 17 experts to answer 'yes,' 'no,' or 'unsure,' resulting in a study on university professors' creativity ability.

3.1. Sampling Techniques

This study examines the impact of a career guidance model on the employment capacity of undergraduate students in China. In Phase 1, 17 Chinese experts with at least a master's degree and five years of experience as associate professors were selected using purposive sampling. Inductive data analysis was employed to interpret the data, focusing on experts in career coaching to gain a deep understanding of the topic. In Phase 2, a model for career advising that impacts employability will be developed. One hundred professors from universities in Sichuan, actively involved in student work, will be randomly selected to participate. In Phase 3, thirty students from Sichuan University of Light and Chemical Technology will be selected using stratified sampling to assess the effectiveness of the career guidance model on employability. The university, a national public institution, offers a range of fields including economics, engineering, science, and humanities across its twenty colleges.

3.2. Instrumentation

The study used semi-structured interviews with a brainstorming method to explore how career advice models and course content impact undergraduate students' employment opportunities in China. The interviews were divided into three sections: curriculum, program content, and implementation challenges. Key areas discussed included career planning, teacher qualifications, and adapting to students' needs. Understanding students' circumstances, career knowledge, and study habits is essential for effective teaching.

Career planning is a vital part of a student's education, and the curriculum should balance theoretical knowledge with practical instruction. Issues like neglecting individual differences and outdated course content are common, and courses often lack industry collaboration. Solutions include improving curriculum design, hiring qualified teachers, and fostering partnerships with businesses to ensure relevant and up-to-date information. Challenges in career planning courses include students' lack of interest and the theoretical nature of the content. To improve engagement, it's suggested to integrate practical experiences, train teachers, and adjust course content to better reflect real-world scenarios. Personalized plans and stronger cooperation with businesses will enhance the effectiveness of career guidance programs.

The semi-structured interviews also aimed to understand factors affecting vocational college students' employment competitiveness. They covered career planning, external influences, and institutional factors that impact employability. By addressing these issues, vocational schools can improve course content, strengthen business partnerships, and better prepare students for the evolving job market.

The study used a questionnaire to evaluate experts' views on the curriculum, course content design, and implementation methods related to employment competitiveness for higher vocational college students in China. Questionnaire I, developed based on semi-structured interview data, included two sections: courses and course content. A five-point Likert scale was used to assess the experts' opinions. The questionnaire focused on factors such as career planning, individual branding, professional connections, management skills, and workplace ethics. It also covered self-evaluation areas like goal-setting, personality assessments, emotional intelligence, and industry-specific skills. The questionnaire further explored support for mentors and networking, with a focus on professional relationship building, industry insights, and job search techniques. Additional topics included resume writing, job interview skills, LinkedIn profile optimization, and workplace wellness. The responses were analyzed using factor analysis, and the qualitative data from interviews were examined for key themes. The results provided insights into the effectiveness of the curriculum in improving students' employability and career development skills. Questionnaire II involved re-evaluating the factor analysis strategies on employment competitiveness for higher vocational college students in China. After collecting responses from Questionnaire I, expert opinions and data analysis were used to compare average values, total scores, and coefficient of variation for each item. The second questionnaire, using a five-point Likert scale, was then sent to experts for the third round of review.

Questionnaire III focused on refining the career guidance model for undergraduate students in China, based on feedback from Questionnaire II. Seventeen experts used a five-point Likert scale to assess the course and its content. The questionnaire addressed five key areas: 1) Orientation and Career Education, including career planning, branding, professional networking, and leadership; 2) Self-evaluation, covering goal-setting, personality evaluation, emotional intelligence, and skill development; 3) Mentorship and Networking, emphasizing professional growth and industry insights; 4) Mentor Support, including job search assistance, interview techniques, and workplace wellness; and 5) Employment Competitiveness Strategies, focusing on labor market analysis, curriculum development, alumni enhancement, career incubation, and post-graduation support. These areas aim to improve students' employability by aligning education with market needs, enhancing skills, and providing real-world experience and networking opportunities. After receiving responses to Questionnaire III, the feedback was categorized and condensed into themes and suggestions. Seventeen experts used Questionnaire IV to finalize the course content for the career guidance model, focusing on its impact on students' employment ability. Responses were rated on a scale of 1 (Agree), 0 (Neutral), and -1 (Disagree), with the results confirmed through percentage analysis.

3.3. Data Collection Procedures

The Delphi technique is used for data collection, sending multiple rounds of written questionnaires to a panel of experts. This method ensures anonymity and minimizes bias, allowing experts to adjust their responses based on feedback from previous rounds, ultimately leading to a consensus on the correct answer. In the first round of the Delphi technique, participants are asked to provide as many responses as possible to a set of questions, such as improving students' employability or describing the job market for the year. Responses are given anonymously through a mail or email survey. In the second round, the collected responses are shared with participants, who rate and provide feedback on the ideas, clarifying, adding to, or suggesting new strategies. The third round involves analyzing the feedback from the previous round and asking participants to rate the course content again. In the final round, actionable ideas are identified, prioritized, and reported, with the communication manager focusing on implementation strategies.

At Sichuan University of Light and Chemical Technology, a career guidance model was implemented to enhance employment opportunities for undergraduate students. Thirty students were randomly selected through stratification and enrolled in the model's courses. Their employability was assessed before and after the intervention to measure its impact. The study also aims to optimize and improve the career guidance model to further enhance employment outcomes for students.

3.4. Data Processing and Analysis

The expert authority coefficient (Cr) is calculated to assess the reliability of the expert's input. It takes into account the expert's familiarity with the study (Cs) and the source of their judgment (Ca). A Cr value greater than 0.7 indicates high reliability of the consultation results. The model content was analyzed through a series of rounds, starting with semi-structured interviews that formed the basis for Questionnaire 1. In subsequent rounds, experts used a five-point Likert scale to rate the content, and the data were analyzed using statistical methods such as mean (M), standard deviation (SD), and coefficient of variation (CV). The content was selected based on its mean score, full score frequency, and coefficient of variation, with thresholds set to determine consistency. Consensus was also evaluated using the median, mode, and interquartile range (IQR), with specific criteria for agreement. In the final stage, 17 experts and 100 randomly selected teachers finalized the course content using a revised questionnaire.

Cronbach's α, used to test the internal consistency of the questionnaire, indicates how reliably the items measure the same concept. A coefficient above 0.80 is considered excellent, between 0.71 and 0.80 good, between 0.66 and 0.70 moderate, and below 0.60 poor. This method was applied to analyze reliability. Data collection involved thought questionnaires, and the results were evaluated based on several indicators. The median value should be at least 3.50, the difference between the median and mode should not exceed 1.00, and the IQR should not be higher than 1.5. The IQR values were used to assess whether the opinions were congruent or incongruent, helping to analyze the differences in experts' opinions on selected psychological theories.

The standard deviation measures the spread of data around its mean. A value between 0.000 and 0.999 indicates less dispersion, while values above 1.000 suggest more variation. Interviews and expert judgments focused on psychology theories, qualifications, training methods, and assessments, with similar data addressed through keyword analysis.

Employability differences were compared between pre- and post-test scores using a t-test model for dependent samples. The Likert scale used for student employability was scored from 1 (Strongly Disagree) to 5 (Strongly Agree). Results were analyzed using the mean (M) and standard deviation (SD). Scores between 4.51 and 5.00 represent high opinions, while scores from 1.00 to 1.50 indicate minimal opinions. The arithmetic mean formula was used to calculate the average score, and the standard deviation formula measured the variation in scores. Reliability of the questionnaire was assessed using Cronbach's alpha, with a coefficient of 0.70 or above considered acceptable, and values closer to 1 indicating higher reliability. The formula for Cronbach's alpha was used to calculate internal consistency between items in the questionnaire.

The statistics used to verify the hypothesis involved analyzing employability differences using the dependent t-test. The formula calculates the t-value by dividing the sum of the differences by the square root of the variance, considering the number of students and the sum of squared differences in achievement test scores. The variables include the sum of differences (D), the sum of squared differences (D²), and the total number of students (n). The difference between pre-test and post-test scores for each student (D) is used to compute the results.

In the second stage of the study, 100 teachers were selected through simple random sampling from those who participated in career guidance courses such as career planning and college student mental health, and had advanced degrees in education, psychology, or related fields. The development of the career guidance model affecting employment ability for undergraduate students in China was based on feedback from these teachers. After returning Questionnaire 3, which included eight courses and 39 course contents, the responses were categorized, condensed, and transformed into Questionnaire 4. The survey, combined with participant observation, helped identify key elements of the career guidance model. The researcher also contacted universities and selected participants for the study, distributing questionnaires to 100 tutors. Data were analyzed using frequencies and percentages to assess teacher opinions on the model. The final goal was to develop a theoretical teaching model for autonomous online learning in vocational education.

In the third stage of the study, stratified sampling was used to select 30 students from the second and third grades at each college of Sichuan University of Science and Technology for the experimental class. Stratified sampling ensures each subgroup of the student population, such as grade level, gender, and academic program, is adequately represented. This approach is especially useful when the student population is diverse. The sample was drawn from a total population of 24,858 students. To measure the impact of the career guidance model on employability, a college student employability questionnaire (CSEQ) was used. This instrument, developed and validated by Chinese scholars, includes 17 questions across five dimensions: professional ability, communication skills, cooperation and execution, coordination and adaptability, and thinking and prediction ability.

This study collected data to assess the employability of 30 participants before and after receiving career coaching. A pretest was conducted before the intervention, followed by a posttest to measure changes in employability. The pretest-posttest methodology allows for a direct comparison of employability scores at two different points, evaluating the effectiveness of the career coaching program. Statistical analysis was done using a paired sample t-test, comparing the pretest and posttest scores of the same participants. The t-test determined if the improvement in employability scores was statistically significant, with a p-value of 0.05 indicating a meaningful difference. The results were presented in Table 3 and table 4, showing individual pretest and posttest scores, which were then analyzed to evaluate the impact of the career coaching on employability.

4. Results and Discussion

4.1. Results

This chapter analyzes Factor Analysis Strategies for Employment Competitiveness among higher vocational college students in China. It aims to (1) identify and analyze factors influencing employment competitiveness, (2) evaluate the impact of these strategies on employees' employment ability before and after participation, and (3) enhance employment competitiveness among higher vocational college students. The Delphi procedure is used for data collection, employing both quantitative and qualitative methodologies. Various research instruments are utilized for

data acquisition, collection, and analysis. The chapter highlights the impact of model implementation on employment competitiveness strategies and details the application of the Delphi approach

Principal component analysis (PCA) with Varimax rotation was used to reduce employment competitiveness traits into fewer components explaining most of the variance. The Kaiser-Meyer-Olkin (KMO) Test showed the sample was appropriate, and Bartlett's Test of Sphericity indicated the variables were suitable for factor reduction. Five major components explained 68.7% of the variation. The Factor Procedure yielded percentages for each round of the Factor Analysis Strategy: 1st Round at 15.00%, 2nd Round at 16.00%, 3rd Round at 16.00%, and 4th Round at 16.00%. The Factor Procedure yielded a value of 15.75%. Five critical criteria were defined, representing fundamental characteristics of employment competitiveness strategies for higher vocational college students in China as shown in table 1.

Table 1. Strategies for Factor Analysis to Improve on Employment Competitiveness in Higher Vocational Institutions

Factor Procedure	1st Round	2nd Round	3rd Round	4th Round	Total
1. Professional Skills and Practical Training	15.00%	16.00%	16.00%	16.00%	15.75%
2. Soft Skills and Personal Attributes	15.00%	16.00%	16.00%	16.00%	15.75%
3. Career Guidance and Job Market Awareness	15.00%	16.00%	16.00%	16.00%	15.75%
4. Industry-Academia Collaboration	15.00%	16.00%	16.00%	16.00%	15.75%
5. Technological Literacy and Innovation Skills	15.00%	16.00%	16.00%	16.00%	15.75%
Total	**15.00%**	**16.00%**	**16.00%**	**16.00%**	**15.75%**

The development of professional skills and practical training (factor 1) is vital for preparing students for the job market by facilitating internships, apprenticeships, and partnerships with enterprises. This factor underscores the critical link between education and employment. Furthermore, soft skills and personal attributes (factor 2) are indispensable. These include communication, teamwork, leadership, problem-solving, creativity, adaptability, and resilience. Since employers highly value these skills, vocational education plays a crucial role in nurturing them. Another key aspect is career guidance and job market awareness (factor 3) which provides students with vocational advisory services, employment counseling, and career expos to understand labor trends, sector requirements, and employment search methodologies such as CV composition and interview techniques. Effective career assistance is essential for student success. Collaborations between vocational schools and industries (factor 4), including cooperative education programs, co-ops, employment placements, curriculum development, and competency evaluations, foster strong employer-education partnerships. This alignment ensures that students' training meets market demands, thereby enhancing their employability. Lastly, technological literacy and innovation skills (factor 5) are increasingly important. Proficiency in digital literacy and industry-specific technologies, such as software, machinery, and entrepreneurial competencies, is crucial for success in today's technology-driven world.

Vocational students must acquire digital tools and innovate since technological proficiency is valued in the job market. Technical capabilities, soft skills, career support, industry collaborations, and proficiency are key determinants of job competitiveness among higher vocational college students in China. Professional skills are paramount, emphasizing experiential training. Vocational colleges should focus on practical learning experiences like internships and industrial projects. Soft skills are essential for employment, highlighting the need for a comprehensive educational strategy. Career guidance is crucial for job market navigation. Industry-academia collaboration improves job outcomes by aligning training with market demands. Technological literacy is vital in today's competitive job market. A multi-dimensional strategy is necessary to improve employability. Vocational institutions should prioritize technical training, cultivate soft skills, provide career counseling, engage with industry, and ensure students' proficiency in contemporary technology. This approach will enhance students' preparedness for the job market and augment their employability.

Table 2 assess employees' employability before and after participation. Pre-participation employability assessment assesses baseline skills. Factor analysis determines essential elements for competitiveness, including professional competencies, flexibility, problem-solving, collaboration, communication, and self-regulation. It establishes a standard

for assessing foundational skills and identifying opportunities for enhancement. Post-participation employability assessment evaluates competencies after training or program conclusion. It assesses changes in specified variables, quantifies improvements in technical abilities, problem-solving, and adaptability, and discloses program efficacy. Career guidance and job market awareness are comprehensive.

Table 2. Assess the impact of participation factor analysis strategies on employees' job capabilities before and after.

Factor Analysis Strategies	1st Round	2nd Round	3rd Round	4th Round	Total
1. Pre-Participation Employability Assessment	15.00%	16.00%	17.00%	17.00%	16.25%
2. Post-Participation Employability Assessment	15.00%	16.00%	17.00%	17.00%	16.25%
3. Factor Analysis in Measuring Change	15.00%	16.00%	17.00%	17.00%	16.25%
4. Strategic Implications for Vocational Colleges	15.00%	16.00%	17.00%	17.00%	16.25%
5. Technical Skills Improvement Study	15.00%	16.00%	17.00%	17.00%	16.25%
6. Communication and Teamwork Skills Improvement	15.00%	16.00%	17.00%	17.00%	16.25%
7. Adaptability and Problem-Solving Study	15.00%	16.00%	17.00%	17.00%	16.25%
8. Student Self-Management and Professionalism Prior to Participation	15.00%	16.00%	17.00%	17.00%	16.25%

Access to vocational advisory services, including employment counseling, career expos, knowledge of employment prospects, job trends, and industry demands, and proficiency in job search procedures, are crucial for students' employment results. Vocational colleges should enhance career assistance services. Industry-academia collaboration (16.25%) involves partnerships, cooperative education programs, employment placements, curriculum development, and competency evaluations. This exposure to relevant businesses and market demands improves employability. Technological literacy and innovation skills (16.25%) include digital literacy, proficiency in tools and technologies, industry-specific knowledge, and entrepreneurial skills. Vocational students must acquire these skills as the work market values technological proficiency, especially in rapidly automating and digitizing businesses. The descriptive statistics show a decline in discrepancies between the number of rounds answering the Questionnaire and the consensus results. Experts responded to the Questionnaire, consistent with Macmillan's proposal for a sample size of 17. The linear regression of the Questionnaire on variables reveals a full model from the Delphi technique. Table 3 shows the descriptive statistics of variables.

Table 3. The result of the analysis of the Delphi technique in the SEC Model

	Correlations	Y	X1	X2	X3	X4
Y	Pearson Correlations	1.000	0.841	0.611	0.676	0.637
	Sig.(2-tailed)	0.000	0.000	0.009	0.003	0.006
X1	Pearson Correlations	0.841	1.000	0.413	0.536	0.682
	Sig.(2-tailed)	0.000	0.000	0.099	0.026	0.003
X2	Pearson Correlations	0.611	0.413	1.000	0.698	0.466
	Sig.(2-tailed)	0.009	0.099	0.043	0.056	0.059
X3	Pearson Correlations	0.695	1.000	0.852	0.753	0.230
	Sig.(2-tailed)	0.005	0.000	0.000	0.142	0.374
X4	Pearson Correlations	0.637	0.682	0.466	1.000	1.000
	Sig.(2-tailed)	0.006	0.003	0.059	0.000	0.000
	N	17	17	17	17	17

The analysis of the Delphi technique in the SEC Model from the linear regression of Questionnaire four cycles of Y on X1, X2, and X3, yields a full model for Sichuan Province, China. The analysis aims to understand job competitiveness in Chinese higher vocational colleges, identify components enhancing graduates' employability, understand the complex relationship between factors and their effects on student employment chances, provide career guidance, utilize the employment ability model, and understand the unique environment of China's higher vocational institutions. Figure 2 illustrates the report of factor analysis strategies employment competitiveness.
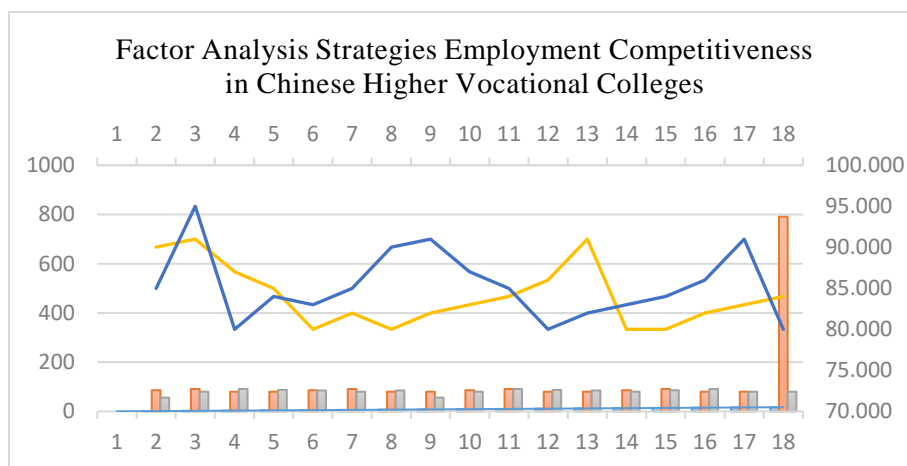
Figure 2. Report of factor analysis strategies employment competitiveness in chinese Higher Vocational Colleges

To improve job prospects for Chinese higher vocational students, education needs to align with the labor market and employers' expectations. Enhancing competitiveness involves aligning curricula with industry needs, fostering industry collaborations, and improving both soft skills and professionalism. Additionally, boosting employability requires focusing on hard and soft skills, work experience, and traits valued by employers. Understanding student employment opportunities requires analyzing academic performance, skills, and external factors like economic conditions and industry trends. Effective career coaching, including personalized counseling, workshops, and seminars on career skills, interviews, resumes, and LinkedIn profiles, helps students acquire marketable skills and find jobs. The employment ability model focuses on essential skills and experiences to prepare graduates for the workforce. Table 4 show the factor analysis of strategies for improving employment competitiveness.

Table 4. Factor Analysis of Strategies for Improving Employment Competitiveness

Category	Agree (%)	Neutral (%)	Disagree (%)
1. Orientation and Career Education	87.5	12.5	0
- Career Planning & Development	86.5	13.5	0
- Professional Networking & Branding	87.5	12.5	0
- Workplace Ethics & Emotional Intelligence	87.5	12.5	0
- Entrepreneurship & Small Business	88.5	11.5	0
2. Self-Evaluation	98.5	10.5	0
- Goal Setting & Personal Growth	86.5	13.5	0
- Strengths, Personality, & Emotional Intelligence	86.0	13.5	0
- Industry-Oriented Skills & Data Analytics	87.0	14.0	0
3. Mentor Support & Networking	88.0	12.0	0
- Professional Relationships & Industry Trends	87.0	11.0	0
- Job Search & Application Support	87.5	12.5	0
- LinkedIn & Resume Optimization	87.5	12.5	0
- Workplace Well-being & Conflict Resolution	87.5	12.5	0
4. Employment Competitiveness Strategies	85.5	12.5	0
- Labour Market & Curriculum Development	86.5	13.5	0
- Career Incubation & Alumni Support	88.0	14.0	0
- Networking & Post-Graduation Assistance	89.0	14.0	0
Total	75.33	19.93	0

4.2. Discussion

In this study, the impact of training programs on the employability of higher vocational college students in China was explored. The findings indicate that students' technical competencies and soft skills, such as communication and collaboration, significantly improved after participating in these programs. However, their adaptability and self-management abilities showed less improvement, pointing to the need for better preparation in handling job-related challenges. The study highlights the importance of experiential learning, work simulations, and mentorship programs

in enhancing employability. Additionally, it suggests that vocational colleges tailor their courses to meet labor market demands, focusing on both technical and soft skills development.

Using factor analysis, key factors such as technical skills, communication, problem-solving, and teamwork were identified as critical to students' employability. The study recommends enhancing adaptability training, incorporating real-world scenarios, and establishing mentorship programs to better prepare students for career success. It emphasizes that employment competitiveness is multifaceted, with both technical and interpersonal skills being crucial. Career guidance plays a vital role in equipping graduates with effective job search strategies. Vocational programs should provide industry-relevant technical training and expand internship opportunities to help students gain practical experience. Collaborating with local industries to offer internships will help students transition smoothly into full-time employment.

The study, however, focused on metropolitan vocational colleges, which may limit its applicability to graduates from rural or smaller institutions. Future research with a larger sample size could improve the generalizability of the findings. Vocational colleges in China should focus on enhancing students' key skills, such as technical proficiency, work experience, and soft skills. Partnerships with local businesses for internships and practical projects can help students develop the competencies required in the workforce. Furthermore, incorporating projects and extracurricular activities can enhance interpersonal skills like communication, problem-solving, and adaptability. Preparing students for emerging technologies such as AI, data analysis, and automation is also essential.

To further improve employability, career guidance programs should teach students self-advocacy, industry standards, and adaptability. Establishing campus counseling services for resume writing, networking, and interview preparation will be beneficial. Promoting an international perspective through language exchange programs and global partnerships can broaden students' horizons. A cooperative education model that integrates internships into academic curriculums will provide students with relevant, practical experience. Encouraging lifelong learning, professional certifications, and feedback-driven curriculum improvements will ensure that students remain competitive in the job market.

5. Conclusion

The results of this study show that vocational training programs significantly improve the employability of higher vocational college students in China, particularly in technical competencies and soft skills such as communication and collaboration. However, students' adaptability and self-management abilities showed less improvement, indicating the need for more preparation in handling job-related challenges. The study emphasizes the value of experiential learning, work simulations, and mentorship programs in enhancing students' employability. Additionally, it recommends that vocational colleges tailor their courses to align with labor market demands, focusing on both technical and soft skills development. Through factor analysis, the study identified key factors—technical skills, communication, problem-solving, and teamwork—that influence students' employability. The findings suggest the need for enhanced adaptability training, real-world scenarios, and mentorship programs to better prepare students for career success. The study also highlights the multifaceted nature of employment competitiveness, emphasizing the importance of both technical and interpersonal skills. Career guidance plays a critical role in equipping students with job search strategies, while vocational programs should provide industry-relevant training and expand internship opportunities to offer students practical experience.

While the study provides valuable insights, its focus on metropolitan vocational colleges limits its applicability to rural or smaller institutions. Future research could benefit from a larger sample size to improve the generalizability of the findings. Vocational colleges should continue focusing on enhancing key skills, such as technical proficiency, work experience, and soft skills. Collaborations with local businesses for internships and practical projects are essential for helping students develop the competencies needed in the workforce. Incorporating projects and extracurricular activities can further improve students' interpersonal skills, such as communication, problem-solving, and adaptability. Furthermore, preparing students for emerging technologies like AI and data analysis will be crucial for future job markets. To further enhance employability, career guidance programs should focus on self-advocacy, industry standards, and adaptability. Establishing campus counseling services for resume writing, networking, and interview preparation will be beneficial. Promoting an international outlook through language exchange programs and global

partnerships can broaden students' perspectives. A cooperative education model that integrates internships into the curriculum will offer practical, relevant experience. Finally, encouraging lifelong learning, professional certifications, and feedback-driven curriculum improvements will ensure that students remain competitive in the evolving job market.

6. Declarations

6.1. Author Contributions

Conceptualization: Y.W., T.S., P.P.V., K.V., and W.W.; Methodology: T.S.; Software: Y.W.; Validation: Y.W., T.S., and W.W.; Formal Analysis: Y.W., T.S., and W.W.; Investigation: Y.W.; Resources: T.S.; Data Curation: T.S.; Writing Original Draft Preparation: Y.W., T.S., and W.W.; Writing Review and Editing: T.S., Y.W., and W.W.; Visualization: Y.W. All authors have read and agreed to the published version of the manuscript.

6.2. Data Availability Statement

The data presented in this study are available on request from the corresponding author.

6.3. Funding

The authors received no financial support for the research, authorship, and/or publication of this article.

6.4. Institutional Review Board Statement

Not applicable.

6.5. Informed Consent Statement

Not applicable.

6.6. Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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