EasyChair Preprint

№ 15734

Adapting to Technological Tides: a Study on the Evolution and Enhancement of Vocational Education Teachers' Competence in China

Xiaoqi Tang, Xinyan Ma, Minyan Liu, Xu Ding, Rong Huang and Junfeng Diao

January 18, 2025

Adapting to Technological Tides: A Study on the Evolution and Enhancement of Vocational Education Teachers' Competence in China

Abstract: *This paper comprehensively analyzes the current status and development strategies of the teaching staff through quantitative research methods. The study points out that the age and teaching experience of teachers significantly impact their performance across various dimensions of teaching competence. Older and more experienced teachers exhibit higher achievements in specific skills, primarily due to their extensive experience and profound professional knowledge. Additionally, the paper deeply explores the alignment between teachers' professional growth and regional educational needs, and proposes targeted development strategies, such as strengthening teacher training and promoting inter-regional educational cooperation, to enhance teachers' teaching competence and their ability to adapt to different educational environments.*

Keywords: *teaching competence, teacher experience, professional growth, educational strategies, vocational education*

1. Introduction

With several rounds of technological revolutions and industrial transformations, human society has transitioned from agricultural and industrial civilizations to an information age driven by artificial intelligence. This shift has profoundly and significantly altered students' learning methods, teachers' teaching methods, and teachers' competence. In today's increasingly fierce reforms of vocational education and vocational institutions, the emphasis on teachers' competence has become the fundamental requirement for improving the development level of vocational education. The professional development of teachers is a critical factor in the overall improvement of teaching quality and the success or failure of educational reform（Tang and Shi，2009）. Addressing the construction of vocational education teaching staff captures the fundamental link in the development of vocational education; without a high-quality "dual-professional" teacher team, it is impossible to have high-quality vocational education or to cultivate technical and skilled talents welcomed by society and enterprises（Mao，2024）. Facing a complex and rapidly changing educational environment, the construction of the teacher team still faces many inadequacies and urgent problems, such as the shortage of "dual-professional" teachers, generally low professional skills of teachers, and weak practical teaching abilities（Han and Guo，2024）.In light of this, this study distributed a self-assessment questionnaire on teaching competences of vocational education teachers in the information age across the country. The aim is to analyze the existing issues in the development of teaching abilities among vocational education teachers in the information age, and to explore feasible development strategies for addressing these deficiencies, with the goal of enhancing the teaching competences of vocational education teachers.

2. Requirements of the Information Age for Vocational Education Teachers' Teaching Competence

Scholars have thoroughly discussed the teaching competence that vocational education teachers should possess in the information age. Ingrid and others propose that critical reflection is an essential component of the practical teaching abilities of vocational education teachers（Berglund et al，2020）; Brennan and Annette emphasize that vocational education teachers apply their industry knowledge and experience to their teaching（Kemmis and Green，2013），stressing that the teachers' industry knowledge and personal experience are indispensable parts of teaching competence. Moreover, Sevilla notes the significant impact of corporate practice experience on teaching competence, believing that compared to regular education teachers, vocational teachers, having accumulated labor market experience, choose

teaching as a second career, with teaching ability being a major deciding factor（Sevilla and Madero，2023）. Researchers like Suarez Guerrero believe that digital competence is crucial for vocational education teachers, finding that while teachers possess the knowledge and skills to apply certain resources and technologies in vocational education teaching practices, they struggle to integrate technology into assessments, and there is still room to improve teachers' information literacy and research abilities（Suárez Guerrero et al，2021）.

Domestic research on the teaching competence of vocational education teachers in the information age has also been localized. For example, Zhang Ni and others propose that in the era of intelligent education, teachers' ICT teaching competences primarily cover aspects such as awareness and attitude, knowledge and skills, design and construction, implementation and evaluation, and reflection and innovation（Zhang et al，2022）. Wu Maqun believes that the teaching competences of teachers in the information age involve six aspects: information-based teaching concepts, course organization and evaluation, the use of teaching methods, the use of technology and equipment, classroom teaching and management, and learning and professional development（Wu，2015）. Xue Dong and others have traced the development trajectory of teachers' digital information teaching competence over ten years, focusing on teachers' competence to design and develop digital resources and tools, their ability to continuously integrate digital technology with traditional teaching, and the importance of teachers' teaching and team collaboration competence（Xue and Wu，2021）. Xu Hongye argues that the teaching competences of teachers in the information age is based on their practical knowledge of informatization, which needs to be formed and developed in certain informatization contexts, including the transfer, integration, interaction, evaluation, and collaboration of informatization teaching, with the core being to promote students' information learning abilities（Xu，2013）. Wang Caixia and others emphasize that teachers' teaching competences should include knowledge and skills in information technology, knowledge of educational technology theory, teaching design abilities, software design and production competences, and teaching research abilities（Wang and Zhan，2014）.

In summary, this article, based on the existing research results and the teaching competence standards of elementary school teachers, university teachers, teachers' informatization teaching competence standards, and vocational college teachers' teaching competence standards, divides the components of vocational education teachers' teaching competence into six aspects: course development, course teaching, professional knowledge, industry capability, information literacy, and research and development abilities.

3. Methods and analysis

This research aims to analyze the existing challenges in the development of teaching competences among vocational education teachers in the information age and explore feasible strategies to address these deficiencies, with the goal of enhancing the teaching competences of vocational education teachers. The research team distributed 1024 self-developed self-assessment questionnaires on the teaching competences of vocational education teachers in the information age nationwide. The questionnaire comprises six dimensions: Course Development Ability, Course Teaching Ability, Professional Knowledge, Industry Knowledge, Information Literacy, and Research and Development Ability. These dimensions are based on a framework specifically designed by Junfeng Diao and others, as outlined in their article "Preparing TVET teachers for sustainable development in the information age: Development and application of the TVET teachers' teaching competency scale" （Diao and Hu，2022）. This framework addresses the evolving demands and challenges in vocational education amid digital transformation, aiming to comprehensively assess and enhance the pedagogical competences of vocational education teachers to meet the requirements of the information age. This structured approach is essential for systematically identifying strengths and potential areas for improvement in teaching practices, ultimately supporting the overall goal of raising educational standards in vocational settings. From 2021 to 2023, in-service vocational college teachers who participated in the digital teaching skills

enhancement training organized by the research team participated in the survey using the online questionnaire tool "Questionnaire Star," resulting in a total of 1024 valid questionnaires received.

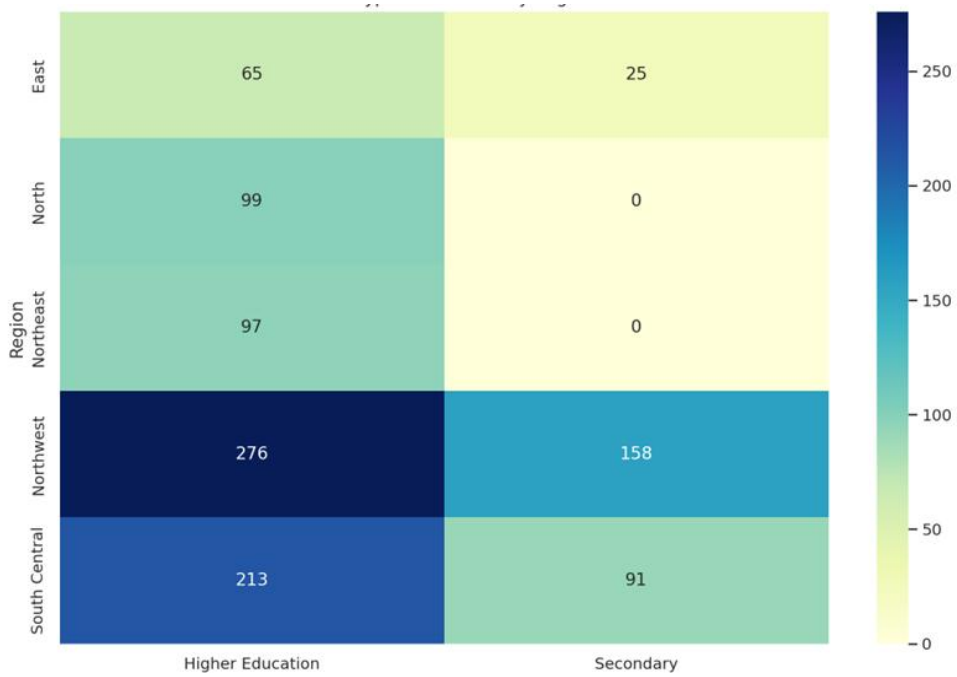
3.1. Personal Characteristics of Teachers

From the perspective of teachers' personal characteristics, the current teaching competences of vocational education teachers exhibit significant regional distribution differences, gender imbalances, and uncoordinated distribution of education levels, with the teacher group overall showing a trend towards higher education levels, diversification of expertise, and commitment to imparting professional knowledge.

In terms of regional distribution of teachers, there are relatively more teachers in East China and Northwest China. Regarding the types of institutions, in higher education, the Northwest region has the most teachers at 276, followed by the Central China region with 213, the Eastern region with 65, the Northeast region with 97, and the North China region with 99; for secondary education, the Northwest region has 158 teachers, the Central China region has 91, the Eastern region has 25, and there are no data for the North China and Northeast regions. Influenced by various factors such as the economic development level of each province, policies, geographical location, and educational resources, the distribution of teachers by region and educational level shows an uncoordinated pattern.

Figure 1

Distribution of School Types by Region



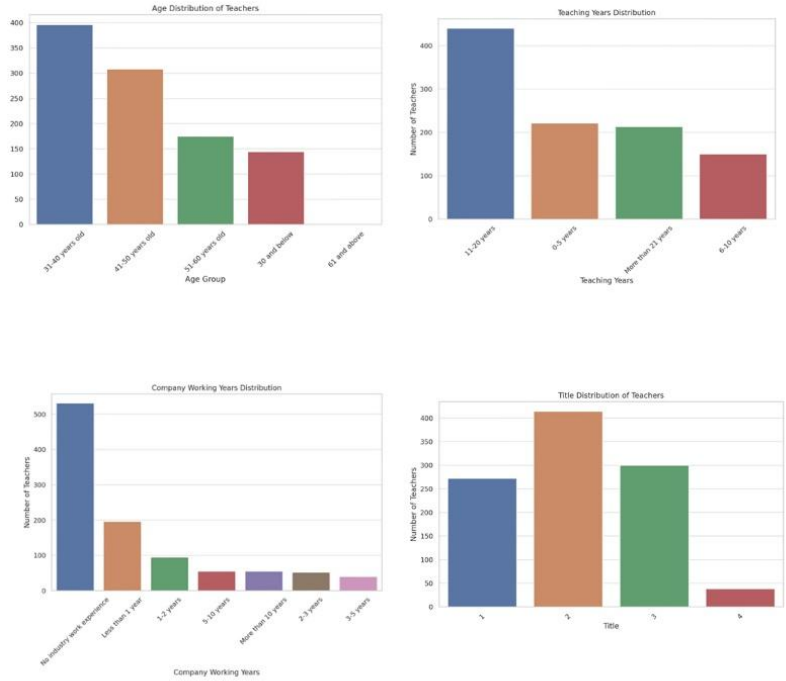
In terms of gender ratios among teachers, in higher education, there are more female teachers (476) than male teachers (274); in secondary education, female teachers (180) also outnumber male teachers (94). The Northwest region has the most teachers in both types of institutions, indicating that this region places greater emphasis on vocational education, with more educational institutions. The number of teachers in higher education far exceeds that in secondary education, which demonstrates that higher education resources are more abundant, receiving more attention and focus. The gender distribution shows that female teachers are in the majority in both types of institutions, reflecting the characteristic of the education industry where women have a higher participation rate in the field.

Age distribution shows that the largest group is teachers aged 31-40, with 396 teachers, followed by those aged 41-50 with 308, 51-60 with 175, under 30 with 144, and only 1 teacher aged 61 and above. In terms of years of work experience in the education industry, teachers with 11-20 years of experience are the most numerous, totaling 440. There are 221 with 0-5 years, 213 with 21 years or more, 150 with 6-10 years, and 531 teachers with no industry work

experience. Next are those with less than one year of work experience at 196, 1-2 years at 95, 5-10 years and over 10 years each at 55, 2-3 years at 52, and 3-5 years at 40. In terms of professional titles, intermediate titles are the most common, with 414 teachers, followed by associate senior titles at 300, junior titles at 272, and only 38 with senior titles.

Figure 2

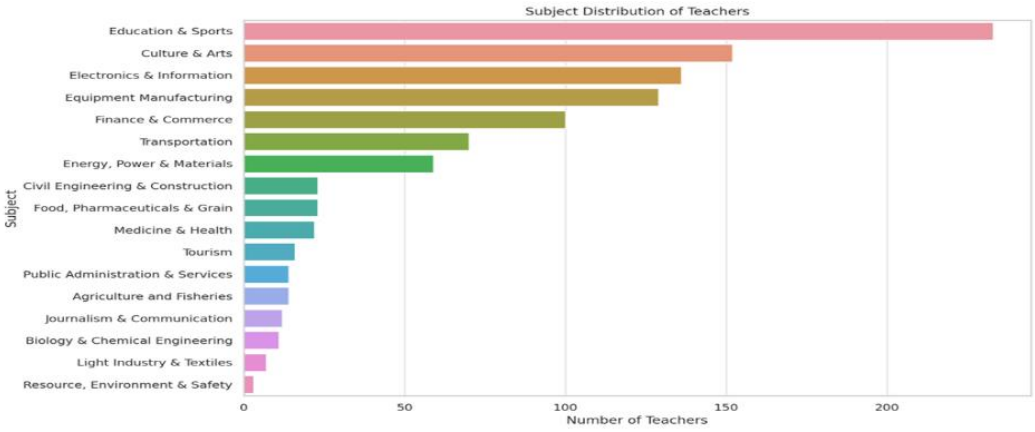
Teacher Age Distribution Chart



In terms of educational qualifications, the majority hold master's degrees (516), followed by bachelor's degrees (382), and other qualifications (107), with relatively few holding doctoral degrees (19). In terms of specializations, the most common are education and sports (233 teachers), followed by culture and arts (152), electronics and information (136), equipment manufacturing (129), and finance and business (100). In terms of the types of courses taught, teachers of foundational professional courses are the most numerous (558), followed by core professional courses (516), basic public courses (402), and advanced professional courses (152).

Figure 3

Distribution of Teachers by Specialty



The distribution of highest academic degrees shows that the majority of teachers hold master's degrees, reflecting a trend towards higher education levels among the teaching staff; the distribution across disciplines indicates that the fields of education and sports have the largest number of teachers, demonstrating a significant demand for teaching in

these disciplines; in terms of the types of courses taught, there are many teachers for foundational professional courses and core professional courses, suggesting that teachers are more involved in teaching professional courses and emphasize the imparting of specialized knowledge.

Through correlation analysis, this study found that there is a significant association between teachers' age and years of work experience, with older teachers having longer tenures; there is a significant correlation between educational qualifications and the types of courses taught, with teachers holding master's or doctoral degrees more likely to be responsible for core professional courses and advanced professional courses; there is a significant association between professional titles and disciplines, with teachers in the natural sciences having higher professional titles; there is a significant correlation between teachers' professional backgrounds and the types of courses they teach, with teachers in the humanities and arts less likely to be responsible for advanced courses; there is a significant correlation between years of work experience and the types of courses taught, with teachers with longer tenures more inclined to teach core professional courses and higher-level courses. These analytical results reveal significant associations between personal characteristics such as age, educational qualifications, and professional titles of teachers and their teaching practices. These correlations may be influenced by the career paths of teachers, the structure of the education system, and personal interests and professional development of teachers. For example, more experienced teachers may be more involved in teaching advanced or core professional courses, while younger teachers may be more engaged in teaching basic courses.

3.2. Teachers' Teaching Competence

In terms of overall scoring of teaching competences, this study conducted descriptive statistical analysis using statistical indicators such as mean, median, and standard deviation to evaluate teachers' self-assessment results on their teaching competencies. This analysis reveals the basic characteristics and trends of the data, providing insights into teachers' overall performance across various dimensions of teaching competencies. The table below presents the descriptive statistical results for teachers across six dimensions of teaching competence:

Table 1.

Descriptive Statistical Results of Teachers' Teaching Competences

Dimension	Mean	Median	Standard Deviation	Minimum	Maximum
Course Development Ability	30.68	30.79	0.89	1.00	5.00
Course Teaching Ability	40.01	40.00	0.79	1.00	5.00
Professional Knowledge	40.01	40.00	0.80	1.00	5.00
Industry Knowledge	30.68	30.78	0.89	1.00	5.00
Information Literacy	30.85	40.00	0.82	1.00	5.00
Research and Development Ability	30.76	30.94	0.86	1.00	5.00

Course Teaching Ability and Professional Knowledge: The mean is 4.01 and the median is also 4.00, indicating that teaching competences in these two dimensions are generally high, with most teachers performing well in these areas. Information Literacy and Research and Development Ability: The mean and median values for these dimensions are slightly lower than for Course Teaching Ability and Professional Knowledge, but still between 3.76 and 3.85, indicating that teachers also perform well in these areas. Course Development Ability and Industry Knowledge: The mean for these dimensions is 3.68, with a median slightly higher than the mean, but a standard deviation close to 0.9, indicating a large variability in teacher performance in these areas. Overall, teachers' self-assessments of their teaching competencies show that they excel in Course Teaching and Professional Knowledge, while there is room for improvement in Course Development and Industry Knowledge.

Regarding regional differences, teachers in the Northeast and North China regions perform best in overall teaching competence scores, with average total scores of 23.84 and 23.76 respectively, which may be related to factors such as educational resources, policy support, and teacher training opportunities in these areas. The average total score in the Central China region is the lowest at 22.21, indicating that teachers in this region are relatively weaker across multiple dimensions of teaching competences and require more support and resources to enhance their teaching competences. The average total scores in the East China, Northwest, and South China regions are in the middle range, indicating that teachers in these areas generally perform well but still have room for improvement.

Table 2.

Average Total Scores by Region

Region	Average Total Score
Central	22.21
Northeast	22.47
North China	23.76
East China	23.84
Northwest	22.90
South	23.01

Furthermore, the Northeast region has the highest average score in curriculum development ability, while the Central China region has the lowest average score; the Northeast region also leads in curriculum teaching ability, with the Northwest region slightly lower than other regions. The Northeast region ranks high in professional knowledge scores, while the Central China region ranks relatively lower. The North China region excels in industry knowledge scores, while the Southwest and Central China regions are relatively lower. The North China region also demonstrates relatively high average scores in information literacy, while the East China region is relatively lower. The North and Northeast regions score higher in research and development ability, while the Central China region scores lower. Overall, teachers in the Northeast and North China regions have higher average scores across multiple teaching ability dimensions, reflecting greater investment in teacher development and training in these regions or superior allocation of educational resources. Relatively, the Central China region generally does not score the highest across multiple dimensions, indicating that teachers in this region may need more support and resources in certain areas.

Regarding the relationship between education level and teaching ability, this study explores whether there are significant differences in the scores of teachers from different education level groups on various dimensions of teaching ability and the total score dimension through analysis of variance, to understand the influence of teachers' highest education level on their teaching ability scores. The p-values for all teaching ability dimensions and total scores are 0.000, indicating significant statistical differences in the scores of teachers from different education level groups on these dimensions. This result suggests a close correlation between the highest education level and teachers' teaching ability scores. Teachers with higher education levels may perform better in curriculum development, teaching skills, professional knowledge, industry knowledge, information literacy, and research ability. This may be because higher education levels are often associated with deeper academic research and professional knowledge, as well as richer teaching and research experience. Based on the results of the analysis of variance, it can be concluded that there are significant differences in the scores of teachers from different education levels on various dimensions of teaching ability and total scores, reflecting the significant impact of teachers' educational backgrounds on their teaching ability.

Table 3.

Differences in Teaching Ability Scores Among Teachers with Different Education Levels

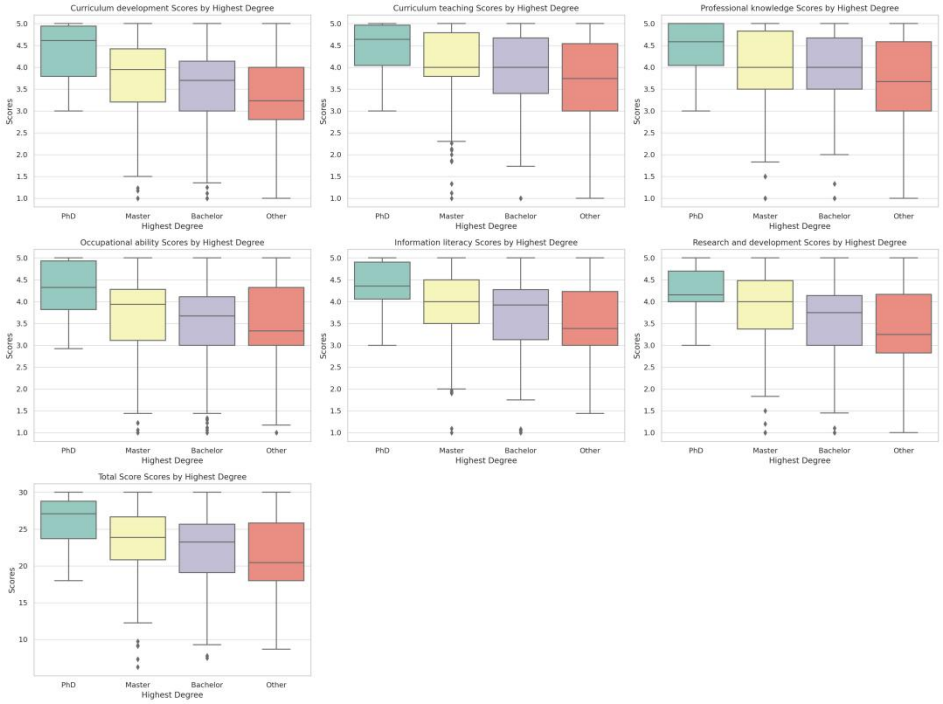
Teaching Ability Dimensions	p-value
Curriculum Development Ability	0.000

Curriculum Teaching Ability	0.000
Professional Knowledge	0.000
Industry Knowledge	0.000
Information Literacy	0.000
Research and Development Ability	0.000
Total Score	0.000

The box plots illustrate the distribution of scores across various teaching competence dimensions and the total score among teachers with different education levels. There are noticeable differences in score distributions among different education level groups across most dimensions. Generally, teachers with higher education levels, such as Ph.D., tend to have higher scores across all dimensions. On most dimensions, the median and quartile ranges of scores for teachers with higher education levels are higher, indicating their overall better performance in these abilities. While there are some outliers present in the score distributions across different education level groups, they are not sufficient to affect the overall trend. The visual results further confirm the findings of the analysis of variance: significant differences exist in the scores of teachers from different education levels across various teaching competence dimensions and the total score.

Figure 4

Differences in Teaching Ability Scores Among Teachers with Different Education Levels



There are significant differences in scores between genders in curriculum development ability, professional knowledge, industry knowledge, and total score (p-value < 0.05). However, there are no significant differences in scores between genders in curriculum teaching ability, information literacy, and research and development ability (p-value > 0.05). The significant differences suggest that gender may influence teachers' performance in specific teaching ability dimensions, possibly related to gender-specific teaching styles, experiences, and cognitive approaches. The lack of significant gender differences in curriculum teaching ability, information literacy, and research and development ability indicates that these teaching abilities are less influenced by gender.

Table 4.

Differences in Teaching Ability Scores Between Genders

Teaching Ability Dimensions	**p-value**
Curriculum Development Ability	0.002

Curriculum Teaching Ability	0.826
Professional Knowledge	0.036
Industry Knowledge	0.000
Information Literacy	0.286
Research and Development Ability	0.061
Total Score	0.025

There are significant differences in teaching ability dimensions and total scores among age groups (p-value < 0.05). This indicates that teachers from different age groups indeed exhibit significant statistical differences in teaching ability scores. These significant differences may be related to the experience, knowledge, and skills accumulated by teachers as they age. Experienced teachers may have higher ability scores in certain dimensions. Meanwhile, younger teachers may excel in certain areas, such as information literacy, indicating their familiarity with modern teaching technologies and methods.

Table 5.

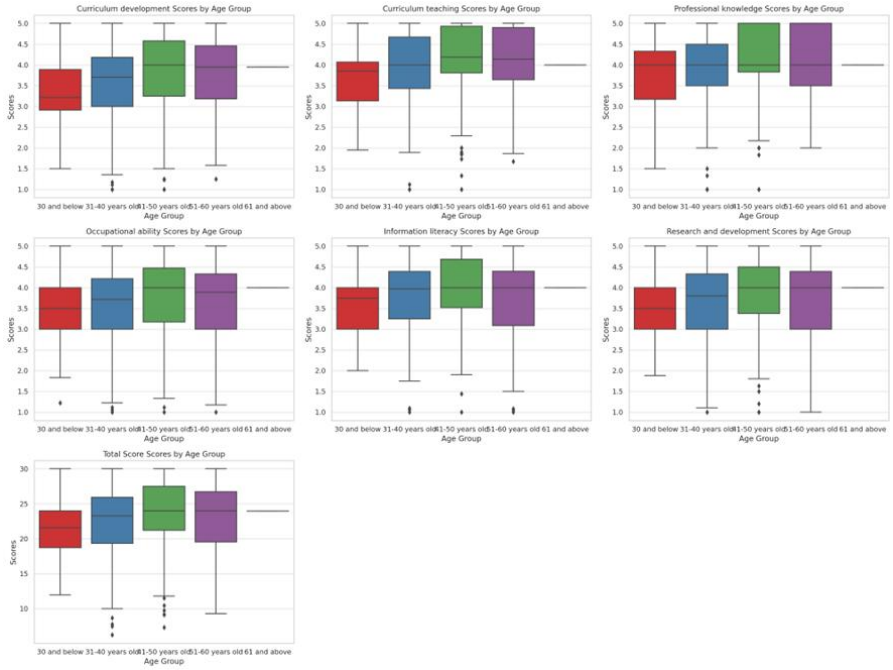
Differences in Teaching Ability Scores Between Age Groups

Teaching Ability Dimensions	**p-value**
Curriculum Development Ability	0.000
Curriculum Teaching Ability	0.000
Professional Knowledge	0.000
Industry Knowledge	0.005
Information Literacy	0.000
Research and Development Ability	0.000
Total Score	0.000

The following figure illustrates that there are significant differences in score distributions across various dimensions among different age groups, consistent with the results of the analysis of variance. In certain dimensions, specific age groups exhibit higher median and quartile range scores, reflecting their advantages in particular abilities. These analytical findings suggest a close correlation between teachers' age and their performance across different teaching ability dimensions. As teachers age, they may perform better in certain abilities, likely due to accumulated experience and deepened knowledge.

Figure 5.

Differences in Teaching Ability Scores Between Age Groups



Furthermore, there are significant differences in scores between teaching experience and teaching ability (p-value < 0.05). Teachers with different teaching experiences indeed exhibit significant statistical differences in teaching ability scores. These significant differences may indicate that as teachers gain more teaching experience, their performance improves across various teaching ability dimensions. Experienced teachers often have advantages in curriculum development, teaching skills, and professional knowledge. However, there may also be a "ceiling effect," where the rate of improvement in certain abilities slows down after a certain number of years.

Table 6.

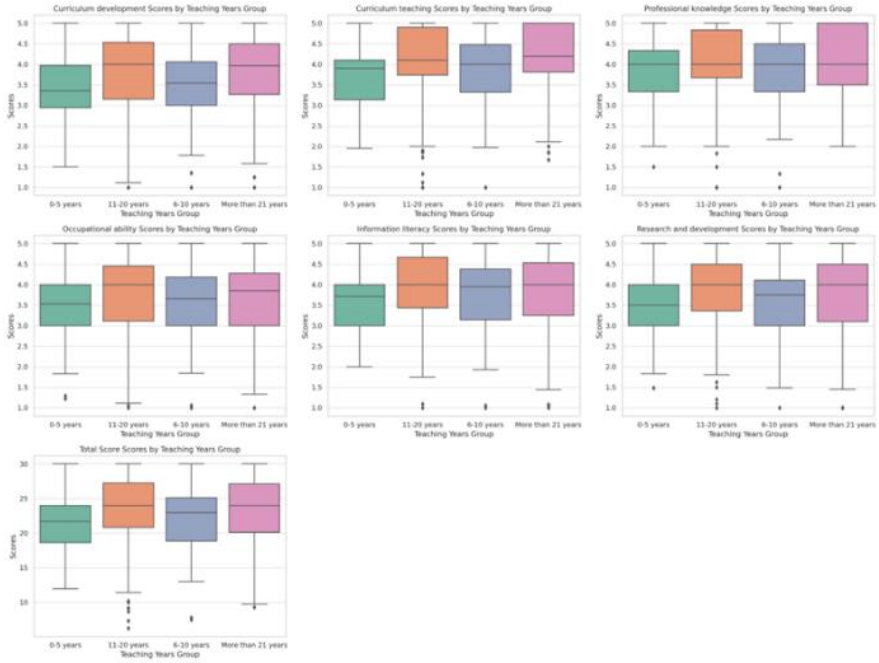
Differences in Teaching Ability Scores Between Teaching Experience Levels

Teaching Ability Dimensions	**p-value**
Curriculum Development Ability	0.000
Curriculum Teaching Ability	0.000
Professional Knowledge	0.000
Industry Knowledge	0.001
Information Literacy	0.000
Research and Development Ability	0.000
Total Score	0.000

The box plots are consistent with the results of the analysis of variance. In certain dimensions, teachers with longer teaching experience have higher median and quartile ranges, reflecting their strengths in these abilities. These analytical findings indicate a close correlation between teachers' teaching experience and their performance across different teaching ability dimensions. As teaching experience accumulates, teachers may excel in multiple dimensions.

Figure 6.

Differences in Teaching Ability Scores Between Teaching Experience Levels



In all teaching ability dimensions and the total score, there are significant differences in scores between professional titles (p-value < 0.05). This indicates that teachers from different professional title groups indeed exhibit significant statistical differences in teaching ability scores. These significant differences suggest that as teachers advance in professional titles, their performance improves across various teaching ability dimensions. Teachers with higher professional titles may perform better in scores due to their richer teaching experience and professional knowledge, reflecting the greater training opportunities and resource access for higher title teachers within the education system.

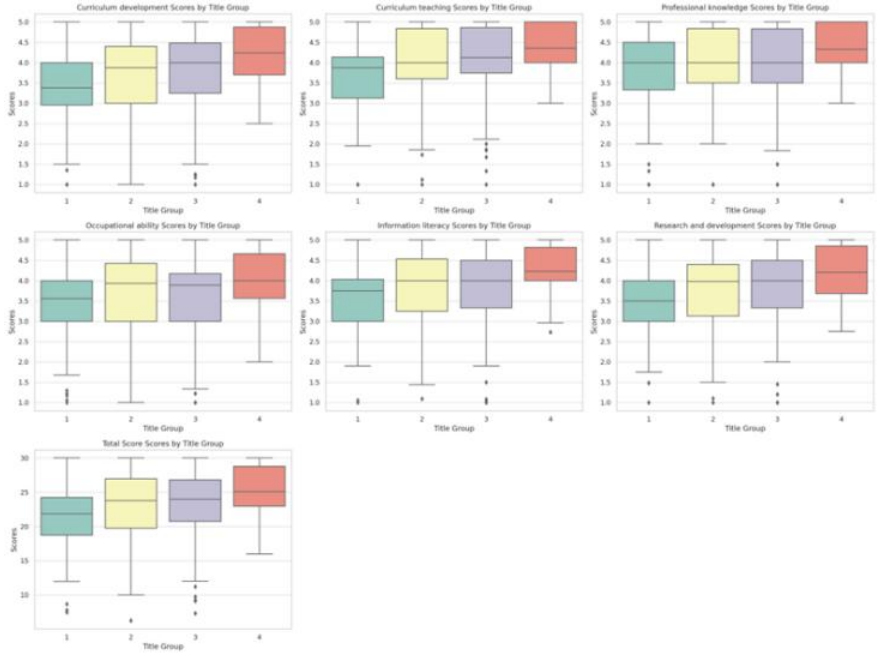
Table 7.

Differences in Teaching Ability Scores Between Professional Title Groups

Teaching Ability Dimensions	**p-value**
Curriculum Development Ability	0.000
Curriculum Teaching Ability	0.000
Professional Knowledge	0.000
Industry Knowledge	0.000
Information Literacy	0.000
Research and Development Ability	0.000
Total Score	0.000

Figure 7.

Differences in Teaching Ability Scores Between Professional Title Groups



The box plot illustrates the distribution of scores across various teaching ability dimensions and the total score among teachers from different professional title groups. There are significant differences in score distributions across different professional title groups in each dimension, consistent with the results of the analysis of variance. In certain dimensions, teachers with higher professional titles have higher median and quartile range scores, reflecting their strengths in these abilities.

Table 8.

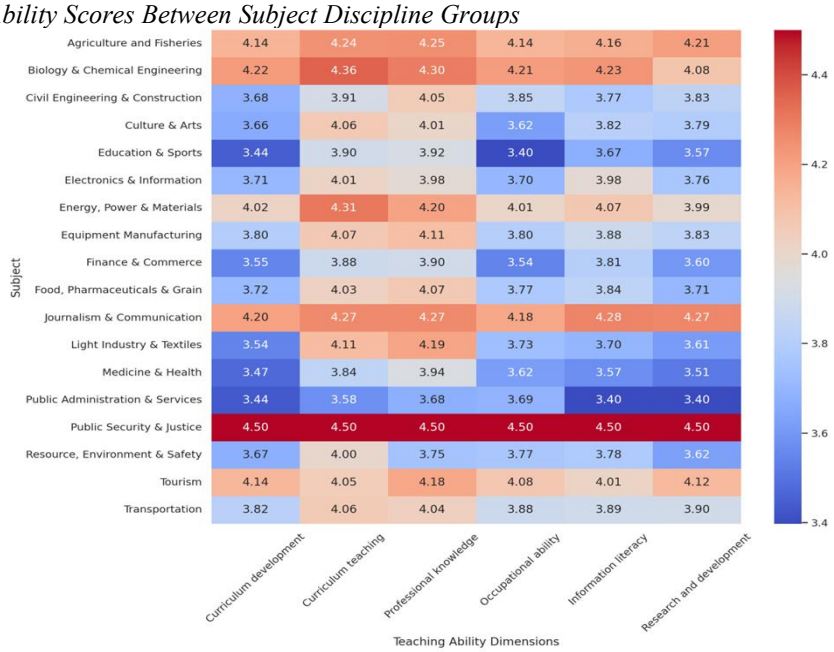
Differences in Teaching Ability Scores Between Subject Discipline Groups

Teaching Ability Dimensions	p-value
Curriculum Development Ability	0.000
Curriculum Teaching Ability	0.010
Professional Knowledge	0.170
Industry Knowledge	0.000
Information Literacy	0.000
Research and Development Ability	0.000
Total Score	0.000

The heatmap illustrates the average scores of teachers from different subject discipline groups across various teaching ability dimensions and the total score. There are notable differences in the average scores across teaching ability dimensions among different subject discipline groups, reflecting the distinct characteristics of these disciplines in teaching ability requirements. Certain disciplines, such as "Public Safety and Justice," demonstrate excellent performance across multiple dimensions, while others, like "Education and Sports," exhibit weaker performance in certain dimensions. These analytical findings suggest a close correlation between teachers' subject discipline and their performance across different teaching ability dimensions. The differences in teaching requirements and content across various disciplines may be key factors contributing to these score disparities.

Figure 8.

Differences in Teaching Ability Scores Between Subject Discipline Groups



All major subject categories show a high correlation between various teaching ability dimensions and the total score, particularly within the natural sciences category, where several dimensions exhibit a correlation close to or reaching 1.0 with the total score. These analytical findings suggest a close correlation between the major subject categories taught by teachers and their performance across different teaching ability dimensions. Particularly, teachers in the field of natural sciences demonstrate excellent performance across multiple dimensions, reflecting the high demands for teaching ability within this field.

Table 9.

Differences in Teaching Ability Scores Between Major Subject Categories

Teaching Ability Dimensions	p-value
Curriculum Development Ability	0.000
Curriculum Teaching Ability	0.010
Professional Knowledge	0.072
Industry Knowledge	0.000
Information Literacy	0.001
Research and Development Ability	0.001
Total Score	0.000

4. Development Strategies for Teaching Ability of Vocational Education Teachers in the Information Age

4.1. Strengthening Teacher Training to Enhance Teaching Skills

Firstly, schools had better understand the relationship between teachers' age, years of service, and teaching ability to formulate appropriate teacher training and development strategies. Teachers under 30 are mainly concentrated in the 0-5 years of service, reflecting their junior stage, while those aged 31-40 are more distributed in the 6-10 and 11-20 years of service, indicating their intermediate stage. Teachers aged 41-50 and 51-60 are mostly found in the 11-20 years and over 21 years of service, revealing an increase in years of service with age. Additionally, teachers' years of service are closely related to their performance across different teaching ability dimensions. With increasing years of service, experienced teachers tend to excel in curriculum development, teaching skills, and professional knowledge, while younger teachers may shine in certain modern teaching areas. The correlation between teachers' age, years of service, and their teaching ability is crucial for teacher training and development.

Based on the analysis above, younger teachers are in the early stages of their careers and may require more support and guidance to adapt to teaching work and improve their teaching ability. On the other hand, older teachers, with more experience, may need professional development opportunities to update teaching concepts and acquire new teaching techniques and methods. To meet the training needs of teachers of different ages, vocational colleges can take the following measures. Firstly, develop personalized training plans. Tailored teaching guidance, curriculum design training, and teaching technology training can be provided for younger teachers to help them establish a solid teaching foundation. For older teachers, specialized professional development courses can be offered to update teaching concepts and acquire new teaching techniques and methods. Secondly, establish and improve mentorship programs, matching experienced teachers with younger ones to help them adapt to teaching work faster and enhance their teaching ability （Lu and Sun，2019）. Lastly, create teacher learning communities to provide a platform for sharing experiences, exchanging teaching methods and techniques, and promoting professional exchange and learning among teachers. Finally, provide on-the-job training opportunities for teachers, including participation in educational seminars, academic conferences, and professional development courses, to help them continuously update teaching concepts and expand teaching skills. Through these measures, schools can better meet the training needs of teachers of different ages, promote professional development, and enhance teaching ability.

Enhancing Curriculum Development Skills and Industry Knowledge Training. There is significant variation in teachers' performance in curriculum development skills and industry knowledge, reflecting differences in individual backgrounds, innovation competences, and interests. Improving these areas requires more training and practical experience. In response, vocational colleges should provide regular training opportunities for teachers in curriculum development skills and industry knowledge, including participation in academic discussions and relevant course studies. Online resources for curriculum development and industry knowledge training should be made available, establishing data repositories and online forums and community platforms for teachers to access learning materials and exchange experiences at any time. Deepening cooperation with industry enterprises can provide teachers with practical opportunities and industry knowledge training, allowing them to understand the latest industry trends and requirements, enrich industry knowledge, and better guide students' career planning. Additionally, gender may affect teachers' performance in certain teaching ability dimensions, particularly in curriculum development skills and industry knowledge. This highlights the importance of considering gender differences in teacher development and training.

Furthermore, when designing training plans, schools should consider the needs and abilities of teachers with different titles. Teachers' titles are closely related to their performance across different teaching ability dimensions. As

titles advance, teachers may perform better across multiple dimensions. Therefore, in designing teacher training plans, schools should first develop different career development paths and training plans for teachers with different titles to help them continuously improve their abilities in curriculum teaching, research and development, and information literacy. For curriculum teaching, training plans for junior title teachers may include training in teaching methods, classroom management, and student counseling to help them establish a solid teaching foundation. For mid-level title teachers, training can focus on teaching design, evaluation, and reflection to enhance their teaching skills. Higher title teachers can receive training in educational leadership and innovative teaching methods to broaden their teaching perspectives. Secondly, schools should interpret and explain the criteria and requirements for title evaluation to teachers according to their different titles, helping teachers clarify their goals and requirements in teaching ability, research level, and professional development. Lastly, schools can establish simulated assessment and evaluation mechanisms for title evaluation, helping teachers understand their actual teaching ability under the title evaluation standards and providing references for improving teaching levels and promoting professional and career development. By considering the needs and abilities of teachers with different titles, schools can design training plans that are more closely aligned with actual needs, helping teachers better improve their teaching ability and achieve professional development goals.

Providing Guidance for Teacher Training and Professional Development Based on Different Professional Backgrounds. This study found significant correlations between teachers' major fields and their performance across different teaching ability dimensions, suggesting that differences in teaching requirements and content across different majors may be key factors in these scoring differences. To address differences in teacher performance in teaching ability across different professional fields, the following solutions can be implemented. Firstly, design targeted training plans. For teachers in the natural sciences category, training can focus on teaching methods, laboratory teaching, and research competences to enhance their teaching ability. For teachers in the social sciences category, emphasis can be placed on classroom interaction, case teaching, and interdisciplinary teaching to improve their teaching ability. Secondly, interdisciplinary training can be organized to allow teachers from different professional fields to exchange experiences and learn from each other, promoting communication and learning among different disciplines and enhancing teachers' comprehensive teaching ability. Thirdly, promote interdisciplinary collaborative teaching. Encourage teachers from different professional fields to carry out interdisciplinary collaborative teaching projects, jointly design and implement interdisciplinary courses to promote the improvement of teachers' abilities in curriculum development, curriculum teaching, and research and development. Fourthly, provide resource support. For social science category professional teachers who may perform relatively poorly in certain teaching ability dimensions, schools can provide more teaching resource support, such as teaching aids, case libraries, and teaching laboratories, to help teachers improve their teaching ability.

4.2. Advancing Teacher Professional Development to Improve Teaching Quality

Firstly, schools should ensure that teachers' academic backgrounds match their teaching content and promote teachers' academic qualifications and professional competence development. The relationship between degrees and the categories of courses taught reveals that bachelor's degree holders mainly teach "public basic courses" and "professional basic courses," reflecting their inclination to teach foundational courses. Master's degree holders are highly represented in all categories, especially in "professional basic courses" and "professional core courses," indicating their significant role in teaching professional-related courses. Teachers with higher academic qualifications are more involved in teaching professional core courses, while those with basic qualifications are more involved in teaching basic courses. Therefore, schools can establish a more flexible teacher allocation mechanism, fully considering teachers' educational backgrounds and professional expertise, to arrange their participation in different types of courses. This can ensure that each course receives teaching support at a professional level, thereby improving teaching quality and students' academic level. Additionally, schools can strengthen the assessment and supervision of teachers' teaching ability, establish a

sound teaching quality assessment system, and motivate teachers to continuously improve their teaching ability and professional level. Finally, vocational education schools should encourage teachers to pursue further education and provide corresponding learning support and resources, such as flexible learning schedules, tuition subsidies, and academic guidance（Yang，2017）. Such measures can motivate teachers to continuously improve their academic level and professional competence, enhance their understanding of teaching content, and thus improve teaching quality and students' academic level.

Secondly, schools should understand the distribution of teacher titles in different professional fields and consider teachers' title levels when formulating teacher professional development plans. In education and sports, culture and arts, and other professions, there are more teachers with mid-level titles. In fields such as electronics and information and equipment manufacturing, associate senior titles hold a significant proportion, attracting many teachers with higher titles. Some specific professional fields, such as public management and services, resource environment, and safety, have fewer teachers with mid-level and senior titles. This distribution reflects the demands and characteristics of teacher title levels in different professional fields, with some professions tending to recruit teachers with higher titles, while others may have more mid-level title teachers. In response, schools can formulate differentiated teacher professional development plans according to the demands and characteristics of teacher title levels in different professional fields. For fields with many mid-level title teachers, efforts can focus on cultivating a group of outstanding teachers to enhance their teaching ability and academic level to meet teaching needs. For fields with many associate senior or senior title teachers, emphasis can be placed on enhancing their teaching innovation ability and research level to promote discipline construction and teaching reform. For fields with fewer mid- and senior-level title teachers, efforts can be made to strengthen talent introduction and cultivation to improve the overall level of the teaching staff. Schools need to enhance support for these fields by providing more research resources, teaching resources, and teaching training support to attract high-level teachers to engage in teaching work in these fields, thus improving teaching quality and discipline construction level.

Additionally, there are significant differences in teacher teaching ability among different regions in China, and the government and educational institutions should formulate teacher development strategies based on regional characteristics. For example, the central region may face problems such as a lack of educational resources and insufficient teaching staff, so particular attention should be paid to investing in educational resources and implementing teacher training plans. The government needs to increase investment in educational resources, including providing more teaching equipment, textbooks, and learning resources; formulate incentive policies, such as providing rewards or subsidies, to encourage teachers to improve their teaching ability and quality; and consider establishing a regular evaluation mechanism to ensure the rational allocation and use of educational resources, thereby improving teachers' teaching level and students' learning effectiveness. The eastern, northwest, and south China regions need to develop more specialized teacher training and teaching method innovation to further improve teachers' teaching ability to meet the special needs of local students and educational development trends. The government can cooperate with higher education institutions to promote the establishment of specialized teacher training programs to cultivate more outstanding education talents with local characteristics to meet the educational needs of different regions. The successful experiences of the northeast and north China regions are worth learning from, and the government and schools should establish interregional education cooperation projects to promote the sharing and learning of successful experiences, allowing teachers to learn from teaching experiences in other regions and improve their teaching ability, thus promoting the overall improvement of teacher teaching ability nationwide. Furthermore, schools can strengthen cooperation by allowing teachers to rotate positions among institutions, allowing them to experience different types of students or teaching situations, summarize experiences, and share teaching views to enhance the depth and intensity of teacher training（Gu et al，2023）.

Finally, to address the issue of mismatch between education levels and teacher gender, the government and schools should pay more attention to the teaching ability of secondary vocational education teachers and the overall construction of the teaching staff. Firstly, increase policy support and resource investment in secondary vocational education, actively establish teacher training programs, cultivate more teachers with practical experience and industry background, and improve the practicality and pertinence of teaching. Secondly, according to gender characteristics, carry out targeted training and learning opportunities in curriculum development, professional knowledge, and industry knowledge to enhance teachers' professional abilities and knowledge levels, encourage and support teachers to adopt diversified teaching styles and methods to meet the learning needs of different students, thereby reducing gender differences in educational ability.

Acknowledgements

We thank all the people who wrote previous versions of this document.

References

Tang, Z., & Shi, W. (2009). Preliminary exploration of the joint school-enterprise support model for professional development of vocational education teachers. *Education and Vocation, 02*, 13-15.

Mao, T. P. (2024). Enlightenment and continuation of the revolution in the higher vocational classroom: The need of the times, the reality of the disease and the solution to the masking. *Education and Career, 04*, 56-62. https://doi.org/10.13615/j.cnki.1004-3985.2024.04.009

Han, F., & Guo, G. (2024). Vocational education enabling new quality productivity: Theoretical logic, practical blockage and innovative path. *Vocational Education Forum, 40*(03), 5-14.

Berglund, I., Gustavsson, S., & Andersson, I. (2020). Vocational teacher students' critical reflections in site-based education. *International Journal of Training Research, 18*(1), 22-36. https://doi.org/10.1080/14480220.2020.1747784

Kemmis, R. B., & Green, A. (2013). Vocational education and training teachers' conceptions of their pedagogy. *International Journal of Training Research, 11*(2), 101-121. https://doi.org/10.5172/ijtr.2013.11.2.101

Sevilla, M. P., & Madero, C. (2023). Factores que influyen en la elección de la carrera docente en escuelas secundarias técnico-profesionales chilenas. *Archivos Analíticos de Políticas Educativas, 31*(41). https://doi.org/10.14507/epaa.31.7458

Suárez Guerrero, C., Ros Garrido, A., & Lizandra, J. (2021). Aproximación a la competencia digital docente en la formación profesional. *Revista de Educación a Distancia (RED), 21*(67). https://doi.org/10.6018/red.431821

Zhang, N., Huang, L., & Guo, Z. (2022). Research on the development paths of vocational education teachers' informational teaching abilities in the era of smart education. *Vocational and Technical Education, 43*(11), 28-33.

Wu, M. (2015). Research on the training framework for improving informational teaching competences of teachers in vocational colleges. *Guangzhou Vocational Education Forum, 14*(03), 1-4.

Xue, D., & Wu, J. (2021). Digital teaching competences of vocational education teachers: Reference framework, development context, and enhancement strategies—Based on an analysis of the National Vocational College Teachers' Informational Teaching competences Competition (1) from 2010-2019. *Vocational and Technical Education, 42*(12), 41-48.

Xu, H. (2013). Research on the problems and countermeasures of informational teaching among teachers at local higher vocational colleges. *Journal of Gannan Normal University, 34*(03), 107-109. https://doi.org/10.13698/j.cnki.cn36-1037/c.2013.03.023

Wang, C., & Zhan, Q. (2014). Current status and improvement approaches of educational technology competences among teachers in vocational colleges. *Vocational and Technical Education, 35*(04), 44-49.

Diao, J., & Hu, K. (2022). Preparing TVET teachers for sustainable development in the information age: Development and application of the TVET teachers' teaching competency scale. *Sustainability, 14*(18), 11361.

Lu, L., & Sun, X. (2019). Enhancement of university teachers' teaching competences in the context of educational informatization. *Modern Education, 6*(44), 78-80. https://doi.org/10.16541/j.cnki.2095-8420.2019.44.029

Yang, C. (2017). SWOT analysis of enhancing teaching competences of teachers in vocational colleges in the internet information era. *Modern Vocational Education, 07*, 39.

Gu, R., Ding, J., Chen, J., et al. (2023). Research on innovative safeguard mechanisms for enhancing the teaching competences of higher vocational teachers. *Industry and Science Forum, 22*(04), 276-277.