International Journal for Housing Science and Its Applications
Publish August 6, 2025. Volume 46, Issue 3 Pages 7597-7608

https://doi.org/10.70517/ijhsa463652

Using Entropy and Path Analysis to Explore the Key Influential Factors in the Community Framework of Virtual Teaching and Research Communities and Their Role in Improving Teachers' Professional Competence

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Abstract The digital era is driving changes in the field of education, and virtual teaching and research communities are increasingly attracting attention as a new platform for teachers' professional development. Based on the UTAUT theoretical model, this study uses entropy value method and path analysis to explore the key influencing factors in the community framework of virtual teaching and research community and their roles in the improvement of teachers' professional competence. Data were collected through the questionnaire method, 240 questionnaires were distributed, and 203 valid questionnaires were recovered to conduct an empirical study on the behavior of virtual teaching and research platform use and teachers' professional competence. The results show that: performance expectations, social influence and personal knowledge management needs have a significant positive effect on teachers' willingness to use the virtual teaching and research platform, with correlation coefficients of 0.458, 0.386 and 0.439 respectively; personal knowledge management needs, enabling factors and willingness to use have a significant positive effect on the behavior of use, and the regression equation is Y = 0.254 × personal knowledge management needs + 0.297 × Enablers + 0.308 x Willingness to use. The overall mean value of teachers' professional competence evaluation was 4.16, with the highest score for teaching behavior (4.22) and the lowest score for teaching skills (4.09). The results of the evaluation of teachers' professional competence based on the entropy method showed that practical teaching development ability (4.31) and spiritual education ability (4.31) were the most recognized competence dimensions by students. This study enriches the research on the influencing factors of virtual teaching and research community at the theoretical level, and provides a basis for constructing an efficient virtual teaching and research community at the practical level, which is of great significance in promoting teachers' active participation in virtual teaching and research activities and enhancing teachers' professional competence.

Index Terms virtual teaching and research community, influencing factors, teachers' professional competence, entropy value method, path analysis, social influence

I. Introduction

Teachers, as a special social group, need to face multiple pressures from families, schools, parents and society [1]. This means that although teachers have the willingness to update their own education and teaching concepts and improve their own skill levels, due to limited time and energy, it is difficult for them to systematically and comprehensively learn modern education and teaching theoretical knowledge and master diversified operational skills through a relatively short period of time [2]-[4]. Most teachers in front-line schools have little opportunity to have in-depth discussions with subject experts, except for weekly teaching and research activities with their own teachers [5]. In such a background, teachers' theoretical knowledge cannot be accumulated, technical operations cannot be updated, teaching problems cannot be solved in a timely manner, and classroom teaching efficiency can hardly be improved [6], [7]. The improvement of teachers' ability and professional development directly affects the learning effect of students as well as the quality of education and teaching [8]. Therefore, there is an urgent need to find a way of teacher professional development that supports teachers' independent learning, teaching and research, practice and other activities in an all-round way.

With the continuous advancement of education informatization, teachers' use of the Internet for learning, teaching and research, interaction, reflection and other activities will become the trend of teachers' future teaching and research activities [9]. Among them, the virtual teaching and research community, relying on modern network technology, can provide teachers with an open, dynamic and interactive network teaching and research platform

[10]. It has many advantages, on the one hand, it can be used as a good platform for knowledge management and teaching reflection, on the other hand, it can also unite education experts and post-service teachers to form a teachers' teaching and research community to realize resource sharing and experience exchange [11]-[13]. In the virtual teaching and research community, teachers will successfully complete the transformation of “socialization” and realize the construction of practical knowledge [14]. Only by utilizing the virtual learning community to support teachers' independent learning, collective teaching and research, teaching practice, reflection and other activities, can we effectively guarantee the comprehensive and sustainable development of teachers [15], [16].

The rapid development of information technology has brought about profound changes in the field of education, and virtual teaching and research has gradually emerged as a new type of professional development for teachers and has received widespread attention. Virtual teaching and research breaks through the time and space limitations of traditional teaching and research, creates a more open and democratic communication platform for teachers, and enables teachers to discuss teaching and learning issues and share resources across geographical boundaries. Modern teachers are faced with increasingly complex educational environments and ever-increasing professional development requirements, and the traditional school-based teaching and research model has been difficult to meet the diversified and individualized professional development needs of teachers. As an important support system for teachers' professional development, virtual teaching and research communities provide teachers with a platform for independent learning, collaborative inquiry and resource sharing, and their role in improving teachers' professional competence is becoming more and more prominent. However, at present, the degree of teachers' use of virtual teaching and research platforms is uneven, and the influencing factors are complex and diverse, so how to promote teachers' effective participation in virtual teaching and research activities and enhance teachers' professional competence has become an important issue that needs to be paid attention to by educational researchers and administrators. Scholars at home and abroad have explored the construction and application of virtual teaching and research communities from different perspectives, but there is a relative lack of systematic research on the key influencing factors in the community framework of virtual teaching and research communities, especially the lack of in-depth exploration of how these factors affect the enhancement of teachers' professional competence. Therefore, it is of great theoretical value and practical significance to systematically explore the key influencing factors in the community framework of virtual teaching and research communities and their role mechanisms on teachers' professional competence enhancement. This study takes secondary school teachers as the research object, adopts the method of combining literature research and empirical research, based on the UTAUT theoretical model, collects data through questionnaires, and applies the entropy method and path analysis to systematically explore the key influencing factors in the community framework of virtual teaching and research community and their role in the enhancement of teachers' professional competence. Firstly, the model of influencing factors on the use behavior of virtual teaching and research platform is constructed and research hypotheses are put forward; secondly, data are collected through questionnaire surveys, and descriptive statistics, correlation analysis and regression analysis are conducted to validate the research hypotheses; then, an evaluation index system of teachers' professional competence is constructed, and the indexes are empowered based on entropy-value method and analyzed at the overall level and subdimensionally; lastly, based on the results of the research, it is put forward to Countermeasure suggestions to promote teachers' effective participation in virtual teaching and research and enhance their professional competence.

II. Theoretical foundations

II. A. Virtual teaching and research

Virtual teaching and research [17], also known as network teaching and research, teachers' remote training, digital teaching and research, is based on the teaching and learning practices arising from the network technology as an important tool and means of education virtual community teaching and research activities, and virtual community in essence is the same.

This paper defines virtual teaching and research as virtual teaching and research refers to decentralized teachers' individual teaching and research activities supported by network social platforms such as forums, blogs, WeChat and other software, including the recording of teaching reflections, talking about teaching problems, browsing education news and other related activities. The significance of this is to achieve the purpose of solving teaching problems and obtaining professional development through knowledge construction, information exchange, and emotional exchange activities.

The main practitioners of virtual teaching and research are teachers, and the content of the activities is centered on education and teaching, which is the common foundation between virtual teaching and research and traditional teaching and research. Virtual teaching and research in the teaching and research community has an activity space teaching and research board moderators and host teachers to form a management organization, and set teaching

and research norms virtual teaching and research members in the interaction to produce a sense of belonging, the formation of the community's unique culture. In addition, its organizational model is the same as the traditional teaching and research. The above factors indicate that virtual teaching and research has the elements of traditional teaching and research, and the factors that affect traditional teaching and research behavior may also affect virtual teaching and research behavior.

Virtual teaching and research activities have the network society characteristics of virtuality, openness and democracy, which will inevitably break through the framework of traditional teaching and research, so that the subject of teaching and research activities breaks through the circle of teachers, the environment of teaching and research breaks through the geographic circle, the content and objectives break through the circle of disciplines, and the way of organization breaks through the circle of leaders. It has the characteristics of inter-temporal, sharing, asynchronous and economic, and at the same time contains the academic, educational, instructive and authoritative nature of teaching and research, which together contribute to the advantageous position of virtual teaching and research. These features determine that it plays an important role in the three aspects of “realizing the sharing of digital teaching resources, promoting the visualization of teachers’ tacit knowledge, and teachers’ independent professional development under the guidance of experts”.

II. B.Virtual Teaching and Research Community

The concept of virtual teaching and learning communities originated from educational online communities, and its conceptualization began with the exploration of educational virtual communities. Educational virtual community is also called network learning community, network learning community, network learning community, virtual learning community, online learning community and virtual community of practice, which has a common basis with the traditional community or community of practice.

Educational virtual community is a virtual community with learning functions, pursuing educational purposes and realizing educational values. Educational virtual community takes hardware platform technology as the material guarantee, interested activity content as the prerequisite foundation, active communication and interaction as the inner mechanism, and community culture as the fundamental of sustainable development. The virtual teaching and research community is a spiritual and cultural home for dispersed individual teachers to solve educational and teaching problems and obtain professional development through knowledge construction, information exchange and emotional exchange in the virtual environment built by information technology.

II. C.Informal learning

Informal learning is relative to formal schooling or continuing education [18], and refers to the form of learning in which new knowledge is received at informal learning places and times such as work, socializing, and living, mainly in the form of learning by playing, learning by doing, and learning by travelling, for example, reading, salons, and parties. Informal learning exists universally, and research has shown that about all of the knowledge and skills that individuals need in learning and work are acquired through informal learning. Informal learning mainly includes the forms of individual introspection, two-person collaboration, practice groups and network groups, etc., and the characteristics of informal learning are proposed, the main contents are:

1) Informal learning is self-initiated, self-regulated and self-responsible by learners.
2) Informal learning is social.
3) Informal learning is in various forms and it is a kind of blended learning;
4) Informal learning emphasizes more on the collaborative nature, communication and sharing among individuals.
5) Informal learning can either have a clear purpose or be accidental.

Informal learning based on the network environment is a multidimensional form of learning, and it is also an important way of adult on-the-job learning, as well as for teachers, who acquire knowledge in the network according to their own needs is informal learning. Teaching and research activities in the network environment have expanded the space for informal learning in both breadth and depth, which makes teachers' learning no longer confined to regular teaching and research activities. Teachers can communicate and discuss teaching issues with teachers in different regions after work, and these informal exchanges have implied wisdom and value. In addition, when teachers participate in online teaching and research, they can obtain the information they need through this informal learning method, which caters to the development requirements of the new curriculum reform concept while forming online behavioral skills.

II. D.Input learning

The theory of engaged learning is that learners take an active role in engaging in meaningful learning activities and tasks, and that more engaged learners gradually increase their learning responsibilities and tasks and seek

deeper understanding from their experiences for direct application to their lives. The basic idea of this theory is to form successful collaborative teams in modern teaching and learning environments so that they can engage in meaningful learning based on certain tasks; the main premise is that effective learning can only occur if the learner is fully engaged in the learning activity. Kesley proposes that there are three basic principles of input learning theory: 1) the principle of getting along, also known as the principle of mutual collaboration, refers to input learning emphasizes the cooperative efforts of the team. The principle of creativity, also known as the principle of project orientation, refers to the fact that engaged learning should treat learning as a creative and purposeful activity. (iii) The principle of contribution, also known as the principle of authenticity, refers to the fact that learners in engaged learning should be encouraged to orient their learning in a broader and authentic social system and to contribute to the external real world. In other words, the input learning theory states that the promotion of learners' engagement in learning is based on three main approaches, namely project-based learning tasks, emphasizing teamwork among learners, and having an external authentic focus. In addition, the input learning theory has three main elements - affective input, cognitive input and behavioral input.

Virtual Teaching and Research is an IT-supported way for teachers to learn online, therefore, the Input Learning Theory is supportive of it. Teachers' participation in online teaching and research fully embodies the three principles of the input learning theory. Teachers can collaborate and communicate with other teachers on the problems they encounter in teaching and research when conducting online teaching and research, and while expressing their own ideas, they can learn from others' viewpoints and build and share resources to contribute to the teaching and research team. The emergence of online teaching and research provides a broad space for the application of the input learning concept in teacher learning and development.

III. Research models and hypotheses

III. A. UTAUT theoretical model

Prior to the study of influencing teachers' use of online platforms for teaching and research activities, theories related to the study of technology acceptance were summarized. In this study, the more typical integrated technology acceptance model was chosen as the theoretical support.

The Integrated Technology Acceptance and Use Model (UTAUT) was born [19], [20], which involves multiple disciplines in the model construct, and has become a new theoretical model for studying users' acceptance of information technology. The UTAUT model points out that performance expectations, effort expectations, as well as social influences, and facilitation conditions affect users' behavioral intentions, and adds four moderating variables, namely, age, experience, voluntariness, and gender. Performance expectation refers to the degree to which individuals believe that the system can systematically help them do their jobs better; effort expectation refers to the degree to which individuals believe that the system is easy to use; social influence refers to the degree to which individuals feel influenced by the surrounding groups, which mainly includes subjective norms, social factors, and external public image; and facilitating conditions refers to whether individuals use the system's personal knowledge and organizational resources. Among them, willingness to use and facilitating conditions act directly on using behavior, and performance expectation, effort expectation and community influence act on using behavior through willingness to use. After empirical research, the researcher concluded that the UTAUT model has a higher degree of explanation for behavioral intention compared to other technology acceptance models, with a strength of explanation for behavioral intention of more than 70%, and is considered to be able to measure and predict users' behavioral intention and actual behavior towards information technology very well.

In this paper, in the process of researching the virtual teaching and research community community framework, the virtual teaching and research platform teacher use behavior is used as a representative research variable. The initial model of factors influencing online teaching and research use behavior is shown in Figure 1.

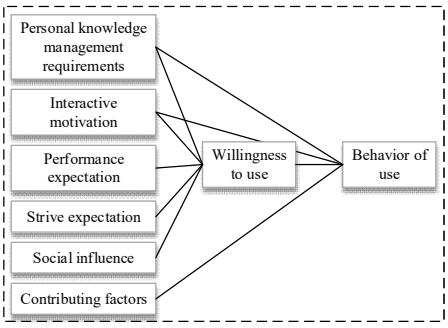

Figure 1: Influence factor model of the network teaching platform using behavior

III. B. Research hypotheses

Based on the above theoretical studies, this paper proposes the following research hypotheses:

H1: Teachers' performance expectations of online teaching and research platform positively affect teachers' willingness to use online teaching and research platform.

H2: Teachers' effort expectation of online teaching and research platform positively affects teachers' willingness to use online teaching and research platform.

H3: Social influence positively affects teachers' willingness to use the online teaching and research platform.

H4: Teachers' personal knowledge management needs positively affect teachers' willingness to use the online teaching and research platform.

H4a: Teachers' personal knowledge management needs positively affect teachers' use behavior of online teaching and research platform.

H5: Interaction motivation positively affects teachers' willingness to use online teaching and research platforms.

H5a: Interaction motivation positively influences teachers' use behavior of online teaching and research platform.

H6: Enablers positively affect teachers' usage behavior of online teaching and research platform.

H7: Teachers' willingness to use the online teaching and research platform positively affects teachers' behavior of using the online teaching and research platform.

Table 1: General descriptive statistics of variables

Variable	Survey item	Mean	SD
Performance expectation	PE1	4.23	0.768
	PE2	3.70	1.224
	PE3	3.87	0.998
	PE4	3.88	1.174
Strive expectation	SE1	4.12	0.729
	SE2	3.57	0.966
	SE3	4.08	0.728
	SE4	4.20	1.198
Social influence	SI1	3.55	0.912
	SI2	3.57	0.767
	SI3	3.65	0.916
Contributing factors	CF1	3.55	0.729
	CF2	4.14	0.807
	CF3	3.55	1.163
Personal knowledge management requirements	PK1	3.59	1.196
	PK2	3.71	0.741
	PK3	3.79	0.981
Interactive motivation	IM1	3.94	1.162
	IM2	4.35	0.803
	IM3	3.54	0.863
	IM4	4.44	1.161
Willingness to use	WU1	3.73	1.232
	WU2	3.78	0.807
	WU3	4.07	0.892
	WU4	3.95	0.749
Behavior of use	BU1	3.94	0.755
	BU2	3.77	1.169
	BU3	3.60	0.922
	BU4	3.55	0.929

IV. Results of the empirical analysis

IV. A. Descriptive statistics

The following is a general descriptive analysis of the variables of interest in the questionnaire. The question options are "strongly disagree", "somewhat disagree", "uncertain", "somewhat agree", and "strongly agree", which are divided into "1, 2, 3, 4, 5". The main measurements of the variables are the mean and standard deviation, which

are generally considered to be above 3. The larger the standard deviation, the greater the variability of the data, and vice versa, the lesser the variability. The overall descriptive statistics of the variables are shown in Table 1.

As can be seen in Table 1, the mean for each question was above 3.5, indicating that the subjects were more in agreement with all aspects of the use of the virtual teaching and research platform.

IV. B. Correlation analysis

(1) Correlation analysis between independent variables and dependent variables

The degree of correlation between the dependent variables and their hypothesized influencing factors, i.e., the degree of correlation between willingness to use, use behavior, and performance expectations, effort expectations, social influence, personal knowledge management needs, and interaction motivation, as well as the degree of correlation between use behavior, and personal knowledge management needs, interaction motivation, contributing factors, and willingness to use. The correlation coefficients between the dependent variables (willingness to use, use behavior) and their hypothetical influences are shown in Table 2.

As can be seen from the analysis results in Table 2, the level of significant positive correlation between willingness to use and its hypothesized influencing factors is reached at $p<0.01$, i.e., performance expectations, effort expectations, social influences, personal knowledge management needs, and interaction motives have a significant positive effect on willingness to use, with effort expectations having the weakest correlation with willingness to use. The level of significant positive correlation between usage behavior and its hypothesized influencing factors is reached with $p<0.01$, i.e., personal information management needs, interaction motivation, willingness to use, and contributing factors have a significant positive effect on usage behavior.

Table 2: The correlation coefficient between the dependent variable and hypothesis factors

	Willingness to use	
	Pearson	Sig.(2-tailed)
Performance expectation	0.458	0.001
Strive expectation	0.251	0.000
Social influence	0.386	0.001
Personal knowledge management requirements	0.439	0.001
Interactive motivation	0.482	0.001
	Behavior of use	
	Pearson	Sig.(2-tailed)
Contributing factors	0.526	0.001
Willingness to use	0.436	0.000
Personal knowledge management requirements	0.541	0.000
Interactive motivation	0.586	0.001

(2) Correlation analysis between independent variables

The results of the correlation analysis between the independent variables are shown in Table 3, where PE, SE, SI, CF, PK, IM, and WU denote performance expectation, effort expectation, social influence, facilitators, personal knowledge management needs, interaction motivation, and willingness to use, respectively.The maximum value of the Pearson correlation coefficient is 0.792, which is all less than 0.9, so there is no obvious covariance problem and regression analysis can be performed.

Table 3: Variables related to the results of the analysis

	PE	SE	SI	CF	PK	IM	WU
PE	1						
SE	0.425**	1					
SI	0.311**	0.329**	1				
CF	0.435**	0.448**	0.232**	1			
PK	0.365**	0.416**	0.152**	0.366**	1		
IM	0.482**	0.388**	0.187**	0.569**	0.792**	1	
WU	0.455**	0.265**	0.389**	0.425**	0.442**	0.482**	1

IV. C. Regression analysis

(1) Regression analysis of willingness to use virtual teaching and research platform and hypothesized factors

With willingness to use as the dependent variable and performance expectation, effort expectation, social influence, personal knowledge management needs, and interaction motivation as the dependent variables, the regression coefficients are shown in Table 4.

It can be known from Table 4 that the bate coefficient of social influence is 0.267, t=4.297, and the co-occurrence probability Sig=0.000<0.05, indicating that social influence has the best explanatory power for the willingness to use. The effect value of "effort expectation" on "willingness to use" did not reach a significant level (t=-1.586, p>0.05), and the effect value of "interaction motivation" on "willingness to use" did not reach a significant level (t=1.814, p>0.05). The influence degrees of the three variables, namely performance expectation, social impact and personal knowledge management need, on the willingness to use are in the order of social impact > performance expectation > personal knowledge management need. The final regression equation obtained is: Y=0.285× performance expectation +0.295× Social impact +0.225× Personal knowledge management needs.

Table 4: The regression coefficient

Model	Nonnormalized coefficient		Normalized coefficient	t	Sig
	B	SE	Bate		
(constant)	5.526	0.865		6.142	0.001
PE	0.262	0.065	0.285	3.845	0.001
SE	-0.078	0.057	-0.092	-1.586	0.163
SI	0.273	0.052	0.295	4.365	0.000
PK	0.261	0.112	0.225	2.415	0.021
IM	0.154	0.068	0.189	1.814	0.096

(2) Regression analysis of virtual teaching and research platform usage behavior and hypothetical factors

Using usage behavior as the dependent variable, enabling factors, willingness to use, personal knowledge management needs and interaction motivation as the independent variables, regression analysis was conducted, and the resulting regression coefficients are shown in Table 5.

It can be known from Table 5 that the bate coefficient of the willingness to use is 0.308, t=3.027, and the co-occurrence probability Sig=0.001<0.05, indicating that the willingness to use has the best explanatory power for the usage behavior. Among them, the effect value of "interaction motivation" on "usage behavior" did not reach a significant level (t=1.756, p>0.05), and the influence degrees of the three variables of personal knowledge management need, contributing factors, and usage intention on usage behavior were in the order of usage intention > contributing factors > personal knowledge management need. The final regression equation obtained is: Y=0.254× Personal knowledge management needs +0.297× Contributing factors +0.308× willingness to use.

Table 5: The regression coefficient

Model	Nonnormalized coefficient		Normalized coefficient	t	Sig
	B	SE	Bate		
(constant)	-3.745	1.485		-2.684	0.003
PK	0.436	0.189	0.254	2.376	0.015
IM	0.251	0.157	0.196	1.756	0.084
CF	0.429	0.126	0.297	4.016	0.000
WU	0.512	0.214	0.308	3.027	0.001

In summary, this paper assumes that H2, H5, and H5a do not hold, and the rest of the assumptions hold.

V. Research on the professional competence of teachers based on the entropy value method

V. A. Construction of the index system for evaluating teachers' professional competence

This chapter takes the professional competence of secondary school teachers as the research object and constructs the evaluation index system of teachers' professional competence. The construction of evaluation indexes mainly consists of four parts: literature research, preliminary construction of index system, actual demand research, and improvement and determination of index system. First of all, through the literature research method, we understand the main concerns about the evaluation of teachers' professional competence and the content of competence

evaluation, and construct a set of evaluation index system initially; then we communicate with the school leaders and teachers to understand the actual needs of the school and the ultimate goal of the evaluation of professional competence, and carry out the research on the actual needs of the evaluation of professional competence, and then improve and finally determine the evaluation indicators that are in line with the school's actual situation. Then the preliminary index system is improved according to the actual situation of the school, and the index system in line with the evaluation of teachers' professional competence in the school is finally determined.

The entropy method is used to calculate the weights of the indicators to reflect the influence of the indicators at all levels on the evaluation results. Commonly used methods for calculating weights include expert assignment method, hierarchical analysis method, correlation coefficient method, entropy value method, etc., which have their own advantages and disadvantages in practical application.

In this study, we adopt the entropy value method introduced in the previous article to calculate the weights of each secondary index in the evaluation index system and determine the weights of the primary indexes according to the weights of the secondary indexes. First of all, we need to read the scientific research data of all teachers, and then for each content of professional competence, that is, each first-level indicator, we read the data of the corresponding second-level indicator, and then calculate the weights of the data. Since some of the index values are in Chinese, we need to train and represent the word vector first. In this paper, we use the Word2Vec word vector representation method, which is open source and can directly call the corresponding class library to train the word vector, and then use the trained word vector to represent the word vector of all the index values; after training the word vector, we use the entropy value method to compute the weight, and then use the Min-Max method to compute the weights. Firstly, the Min-Max method is used to standardize the data to ensure the reliability of the indicator impact, and then the information entropy and weight of each indicator are calculated; thus, the weight corresponding to each secondary indicator is obtained.

Table 6: Evaluation index system for teacher professional ability

Target layer	Primary index	Secondary index
Teacher professional ability	Teaching ability (X1)	Basic teaching ability (X11)
		Humanistic quality education ability (X12)
		Interdisciplinary application ability (X13)
		Topic research ability (X14)
		Practical teaching ability (X15)
		Information teaching ability (X16)
	Teaching consciousness (X2)	Expression ability (X21)
		Teaching communication ability (X22)
		Professional knowledge and teaching skills (X23)
		Knowledge education ability (X24)
		Mental education ability (X25)
		Behavioral education ability (X26)
	Teaching skill (X3)	Interdisciplinary teaching integration ability (X31)
		Multi-disciplinary teaching fusion innovation ability (X32)
		Professional knowledge ability (X33)
		Reflective exploration ability (X34)
		Innovative teaching application ability (X35)
	Teaching behavior (X4)	Practice teaching development ability (X41)
		Practice teaching implementation ability (X42)
		Practice teaching reflection and evaluation ability (X43)
		Comprehensive practice teaching ability (X44)
		Basic information literacy (X45)
		Information operation and application ability (X46)
		Information evaluation and construction ability (X47)

Combined with the actual needs of the evaluation of secondary school teachers' professional competence, it is necessary to set a base score for each secondary indicator, which is manually configured by the teaching supervisor of the school. Then, combining the base score of each indicator with the corresponding weight, the weight of each first-level indicator of teachers is calculated, and the calculation formula is shown in equation (1):

$$W = \sum_{i=1}^{m} w_i x_i \quad (1)$$

In the above formula, W denotes a particular professional competency of a teacher, and m denotes the number of secondary indicators corresponding to that professional competency. Where w_i and x_i denote the weight of the i th secondary indicator and the corresponding base score, respectively.

V. B. Analysis of the evaluation of teachers' professional competence

Before evaluating teachers' professional competence, the index system for evaluating teachers' professional competence is constructed as shown in Table 6.

The constructed index system for evaluating teachers' professional competence is weighted, and the weights of the indexes are shown in Table 7.

Table 7: Evaluation index weight for teacher professional ability

Target layer	Primary index	Weight	Secondary index	Weight
Teacher professional ability	Teaching ability (X1)	0.2896	X11	0.2044
			X12	0.2078
			X13	0.1963
			X14	0.1183
			X15	0.1457
			X16	0.1275
	Teaching consciousness (X2)	0.2454	X21	0.1498
			X22	0.1721
			X23	0.1571
			X24	0.1625
			X25	0.1764
			X26	0.1821
	Teaching skill (X3)	0.2315	X31	0.1821
			X32	0.2105
			X33	0.1943
			X34	0.2042
			X35	0.2089
	Teaching behavior (X4)	0.2335	X41	0.1376
			X42	0.1165
			X43	0.1512
			X44	0.1514
			X45	0.1426
			X46	0.1471
			X47	0.1536

Table 8: Primary index evaluation results

	Mean	SD	Rank
Teaching ability	4.15	0.525	3
Teaching consciousness	4.18	0.562	2
Teaching skill	4.09	0.548	4
Teaching behavior	4.22	0.523	1

(1) Overall level analysis

The evaluation results were collected by distributing online questionnaires, 240 questionnaires were distributed, 203 valid questionnaires were recovered, and the five-level Likert scale was used as the basis for calculation, and the results of the first-level index scores are shown in Table 8. As shown in Table 8, the mean value of students' evaluation of teachers' professional competence is 4.16, among which, teaching ability is 4.15, teaching awareness is 4.18, teaching skills are 4.09, teaching behavior is 4.22, and the scores of the dimensions of teachers' professional competence are, in descending order, teaching behavior, teaching awareness, teaching ability, and teaching skills,

and, on the whole, the students are satisfied with teachers' professional competence and have some positive evaluations of teachers' teaching behavior has some positive evaluation.

(2) Dimensional analysis

Descriptive statistics were used to analyze the student evaluation of teachers in the dimension of teaching ability. The data analysis is shown in Table 9. The average values of the six secondary indicators of "teaching ability" range from "relatively satisfied" to "very satisfied". As can be seen from Table 9, humanistic quality education ability 4.24= Research topic ability 4.24 > basic teaching ability 4.22 > information-based teaching ability 4.15 > Practical teaching ability 4.07 > Interdisciplinary application ability 4.01 It indicates that students believe there are certain differences in the teaching abilities demonstrated by teachers at different stages of the teaching process.

Table 9: Evaluation results of teaching ability

Teaching ability	Mean	SD	Rank
Basic teaching ability	4.22	0.653	3
Humanistic quality education ability	4.24	0.634	1
Interdisciplinary application ability	4.01	0.615	6
Topic research ability	4.24	0.647	1
Practical teaching ability	4.07	0.612	5
Information teaching ability	4.15	0.685	4

Descriptive statistics were used to analyze the students' evaluation of teachers in the dimension of teaching awareness, and the data were analyzed as shown in Table 10. On the whole, the mean value of students' evaluation of each indicator of teachers' teaching awareness dimension is between 4.08 and 4.31, indicating that students are relatively satisfied with teachers' performance of teaching ability in teaching awareness dimension. The high ratings of 4.31 for spiritual educational competence and 4.29 for behavioral educational competence indicate that students are most satisfied with teachers in these two dimensions.

Table 10: Evaluation results of teaching consciousness

Teaching consciousness	Mean	SD	Rank
Expression ability	4.09	0.815	5
Teaching communication ability	4.14	0.754	4
Professional knowledge and teaching skills	4.15	0.762	3
Knowledge education ability	4.08	0.812	6
Mental education ability	4.31	0.836	1
Behavioral education ability	4.29	0.825	2

Descriptive statistics were used to analyze the teachers' student evaluations in the teaching skills dimension, and the data were analyzed as shown in Table 11. The mean value of student evaluation of the indicators of the teaching skills dimension of young teachers in the arts and sciences is in the range of 4.01-4.22, which indicates that students are relatively satisfied with the performance of teachers' teaching ability in the teaching skills dimension. Among them, the professional knowledge ability of 4.22 and the interdisciplinary teaching integration ability of 4.15 have higher mean levels, indicating that students are more satisfied with teachers' use of multidisciplinary knowledge to solve real-life integrated problems and give higher evaluations to teachers' professional knowledge base integration into the curriculum.

Table 11: Evaluation results of teaching skill

Teaching skill	Mean	SD	Rank
Interdisciplinary teaching integration ability	4.15	0.725	2
Multi-disciplinary teaching fusion innovation ability	4.03	0.786	4
Professional knowledge ability	4.22	0.812	1
Reflective exploration ability	4.01	0.763	5
Innovative teaching application ability	4.07	0.806	3

Descriptive statistics were used to analyze the teachers' student evaluations in the teaching behavior dimension, and the data analysis is shown in Table 12. The mean value of student evaluation of each indicator of teachers'

teaching behavior dimension is in the range of 4.10-4.31, which indicates that students generally approve of teachers' teaching ability in the teaching behavior dimension. Among them, practice teaching development ability of 4.31, information technology evaluation and construction ability of 4.27, practice teaching reflection and evaluation ability of 4.24, comprehensive practice teaching ability of 4.24, and basic information literacy of 4.22 are higher than the average level of teaching behaviors, which indicates that students are more recognizable to the teachers in these dimensions.

Table 12: Evaluation results of teaching behavior

Teaching behavior	Mean	SD	Rank
Practice teaching development ability	4.31	0.715	1
Practice teaching implementation ability	4.10	0.803	7
Practice teaching reflection and evaluation ability	4.24	0.824	3
Comprehensive practice teaching ability	4.24	0.831	3
Basic information literacy	4.22	0.859	5
Information operation and application ability	4.15	0.754	6
Information evaluation and construction ability	4.27	0.836	2

VI. Conclusion

The following conclusions are drawn from the empirical study of key influencing factors and teachers' professional competence in the community framework of virtual teaching and research community:

Performance expectations, social influence and personal knowledge management needs are the key factors influencing teachers' willingness to use the virtual teaching and research platform, with social influence having the best explanatory power, suggesting that the support and recognition of school leaders and colleagues have an important role in promoting teachers' participation in virtual teaching and research activities. Personal knowledge management needs, enabling factors and willingness to use have a significant positive impact on use behavior, with willingness to use having the greatest impact, indicating that improving teachers' willingness to use the virtual teaching and research platform is the key to promoting their effective participation in virtual teaching and research activities.

In the evaluation index system of teachers' professional competence, the weight of teaching ability is 0.2896, the weight of teaching awareness is 0.2454, the weight of teaching skills is 0.2315, and the weight of teaching behavior is 0.2335, which reflects the different contributions of each dimension to teachers' professional competence. The mean value of students' overall evaluation of teachers' professional competence was 4.16, with teaching behavior (4.22) scoring the highest and teaching skills (4.09) scoring the lowest, indicating that teachers performed better in teaching practice behaviors, but there is still room for improvement in teaching skills.

In the future, we should start from strengthening the school's organization and leadership of virtual teaching and research, optimizing the functions of the virtual teaching and research platform, and perfecting the incentive mechanism for teachers, so as to build an efficient virtual teaching and research community, promote the overall improvement of teachers' professional ability, and thus promote the continuous improvement of the quality of education and teaching.

Funding

This work was supported by Zhejiang Province Association of Higher Education 2024 Special Research Project "Research on the Application of Artificial Intelligence to Enable Education and Teaching" [No.: KT2024432].

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