Influential Factors and Promotion Paths of College Teachers' Informatization Teaching Ability

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Abstract-As a practitioner of education informatization, teachers' informatization teaching level is the decisive factor of teaching effect. According to the development logic of teachers' informatization teaching ability, on the basis of the questionnaire survey of college teachers in Liaoning Province, determine the influencing factors of college teachers' teaching ability, and finally use qualitative comparative analysis to explore the path to improve teachers' informatization teaching ability. Research conclusion: The three paths of external force driving, internal driving and expectation driving can improve teachers' informatization teaching ability. Among them, the mastery of information teaching theory, the level of technology application and the frequency of information technology use play the role of driving force, stimulus and cue respectively in the improvement of teachers' information teaching ability; The degree of theoretical mastery has the strongest correlation with the informatization teaching ability.

Keywords-Information teaching; Influencing factors; Promotion Path

1 INTRODUCTION

As an endogenous variable of educational systematic change, educational informatization promotes the renewal of educational concept, mode change and system reconstruction in China. Traditional teaching and learning has changed to online learning and real-time interactive multi-user cooperation in the network environment. Teacher professional development is an important factor to achieve educational reform. The development of education informatization can not be separated from the improvement of teachers' informatization teaching ability. How to break through the multiple patterns of influencing factors of teachers' informatization teaching ability and explore ways to improve them have become one of the important factors to promote educational reform [1]. The existing research on teachers' informatization teaching ability mainly includes three aspects: the embedded research of informatization teaching on curriculum, the research on the impact of informatization on education, and the research on the improvement of informatization teaching ability. To sum up, few literatures have made in-depth empirical analysis on the influencing factors of informatization teaching ability. Based on this, through the survey of college teachers in Liaoning, the correlation analysis is used to reflect the current situation of the multi influence of college teachers' information based teaching ability,

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and the qualitative comparative analysis method of QCA (Qualitative Comparative Analysis) is used to sort out the path to improve the information based teaching ability. It is expected to comprehensively consider the multiple patterns of influencing factors and effective ways to improve the recognition ability, so as to promote the implementation of education informatization and realize the transformation of education innovation integration.

2 LOGICAL ANALYSIS OF THE DEVELOPMENT OF COLLEGE TEACHERS' INFORMATIZATION TEACHING ABILITY

According to the behaviorist learning theory, the learning process can be summarized as the generation of driving force. In addition to the reaction formed by external incentives, the reaction will react to strengthen the driving factors. The process of teachers' information-based teaching can also be seen as a drive response strengthening cycle. With the formulation and deployment of China's education informatization development strategy, the in-depth development of education information technology, and the increasingly mature construction of hardware carriers, all provide the possibility for the in-depth development of informatization teaching. Generally speaking, for teachers, teaching theory can enable them to formulate teaching objectives and evaluation systems scientifically[2]. The more deeply they understand the information based teaching theory, the greater the significance of guiding practice, that is, they can better integrate scattered resources to form an information based teaching design with clear objectives. Therefore, the informatization teaching theory can be regarded as the driving force to improve the informatization teaching ability. The application level of technology helps teachers to design courses more flexibly and improve classroom efficiency. The TPACK framework of subject teaching knowledge integrating technology proposes that teachers have three core elements in the process of integrating information technology and teaching[3], namely, technical knowledge, subject knowledge and pedagogical knowledge.

Among the three core elements, only technology is the only field with clear distinction, so it is believed that the level of technology application will stimulate teachers to continuously improve their information based teaching ability. The performance of reinforcement in Skinner's reinforcement theory is that after a certain behavior occurs, there is a suggestion that the frequency of use can play a role in improving the ability of information teaching.

To sum up, the mastery of information teaching theory, the level of technology application and the frequency of information technology use play the role of driving force, stimulus and cue respectively in behavioral learning, influencing and promoting each other, and ultimately continuously improving college teachers' information teaching ability.

3 RESEARCH DESIGN AND RESEARCH

3.1In depth interview and questionnaire design

First of all, the logic of the development of college teachers' informatization teaching ability was verified through in-depth interviews. The interviewees included 4 teachers who had presided over and completed provincial education reform projects, 3 teachers who had won provincial teaching achievement awards, and 4 school leaders in charge of teaching, totaling 11. The interviewees said that the school encourages teachers to carry out teaching method research to promote teaching reform with the help of theoretical exploration. A series of teaching activities are also aimed at improving teaching ability through teaching reflection. The improvement of teachers' informatization teaching level depends on the joint efforts of individuals and schools. The interview shows that the current college education informatization reform is a cycle process of driving, reacting, strengthening and improving, which is consistent with the development logic of teaching ability. However, the impact of various factors on the current situation and the specific path of improvement are still lack of empirical research. In view of this, in order to better analyze the influencing factors and improvement paths of college teachers' informatization teaching ability, questionnaires were designed and investigated. See Table 1 for specific questions of questionnaire design.

Table 1 Questionnaire Design

Problem classification	Problem design	Option
Informatization teaching ability	Whether to use information technology s killfully in teaching	Very skilled, average skilled, average, not very skilled, not used
Drive	Mastery of teaching related theories	Very good, good, average, poor, very bad
A stimulus	Proficiency in various IT software and pl atforms	Very good, good, average, poor, very bad
Reminder	Frequency of using information technolo gy	Always used, often used, average, not used, not used
Management status	Whether to participate in information tea ching related training	Y, N
	Whether to conduct teaching reflection a nd improvement	Y, N
	The school attaches importance to inform ation teaching	Very good, good, average, poor, very bad
	Does the school have an educational infor matization development plan	Y, N
	Are you willing to share resources on the network	Y, N

3.2 Questionnaire survey and data collection

This questionnaire survey is only for college teachers. Liaoning has a large number of colleges and universities, covering all kinds of colleges and universities, and the survey samples are extensive. The survey process was conducted among college teachers with paper questionnaires, 240 copies of which were distributed, and 160 valid questionnaires were finally recovered. First,

SPSS19.0 was used to analyze the reliability of the questionnaire [4]. The Cronbach's a value was 0.85, greater than 0.80, and the internal reliability of the questionnaire was good. The basic information of the interviewed teachers is shown in Table 2.

Table 2 Basic Information of Interviewed Teachers

statistical indicators		Number of people	Proportion
Gender	men	84	52.5%
	women	76	47.5%
Subject	Literature and History	27	16.9%
	Science and engineering	133	83.1%
Length of Teaching	Less than 5 years	77	48.1 %
	5-10 years	46	28.8%
	11-15 years	30	18.7%
	More than 15 years	7	4.4%
Title	assistant	49	30.6%
	lecturer	76	47.5 %
	associate professor	27	16. 9%
	professor	8	5.0%

4 AN ANALYSIS OF THE MULTIPLE INFLUENCING FACTORS OF COLLEGE TEACHERS' INFORMATIZATION TEACHING ABILITY

4.1 Statistical analysis of single factor description

From the perspective of problem dimension, single factor description statistics includes five parts: proficiency, theoretical mastery, technical level, frequency of use and management status (see Table 3). According to the question options from low to high, 1 to 5 points will be given, that is, unskilled, very poor, and not using will be given 1, and very skilled, very good, and always using will be given 5. In Yes/No selection, Yes is 1 and No is 0.

Table 3 Descriptive Statistical Results

Problem design	Dimension	Mean Value	Standard Deviation
Whether the students are proficient in using information technology in teaching	Proficiency	3.79	0.96
Mastery of teaching related theories	Theory Mastery	3.54	1.72
For all kinds of information technology software and Proficiency in using the platform	technical level	4.13	0.78
Frequency of using information technology in the teaching process	Frequency of use	4.28	0.92
Whether to participate in information teaching related training		0.24	0.47
Whether to conduct teaching reflection and improvement		0.19	0.71

The school attaches importance to information teaching	Management status	4.08	2.41
Does the school have an educational informatization development plan		3.92	0.87
Are you willing to share resources on the network		0.64	0.46

According to the statistical results, the average value of the "frequency of use" dimension is the highest, followed by the "technical level", which is also a manifestation of the popularity of education informatization in college teaching and the extensive application of education informatization platform or related software in teachers' teaching; The average value of the "theory mastery" dimension is low, which reflects that teachers' reflection and summary on education informatization are slightly lacking, and there may be a phenomenon of "application for application". This is also consistent with the low average value of teaching reflection in the "management status quo". In the five aspects of the "management status quo" survey, the school has the highest score for attention, but the average value of teachers' participation in training and teaching reflection is low, indicating that there is a deviation between the school's education informatization construction and teachers' self-development planning, and it is necessary to explore the development path of the joint role of schools and teachers.

In the development logic, it is proposed that the mastery of information teaching theory, the level of technology application and the frequency of information technology use play the role of driving force, stimulus and cue respectively in the improvement of teachers' information teaching ability. The performance of each variable in the logic system in practice is not the same, but also affects each other. It is necessary to further measure the correlation of the development logic variables to understand the multiple impact pattern of the development of teachers' information based teaching ability.

4.2 Response analysis of multiple influencing factors

In order to understand the mutual influence degree of each variable dimension of the development logic, take the informatization teaching proficiency as the dependent variable (Y), the theoretical mastery degree (X_1), the technical level (X_2) and the frequency of use (X_3) as the independent variables, and assign the same values to the options. Pearson correlation coefficient was measured with SPSS19.0, and the results are shown in Table 4.

Table 4 Pearson correlation coefficient of influencing factors

Variable dimension	Index	Proficiency	Theory Mastery	Technical Level	Frequency of Use
Proficiency	Pearson correlation	1	0.255**	0.245**	0.118
	Significance (double tail)		0.001	0.002	0.136
Theory Mastery	Pearson correlation	0.255**	1	0.264**	0.045
	Significance (double tail)	0.001		0.001	0.572

technical level	Pearson correlation	0.245**	0.264**	1	0.208**
	Significance (double tail)	0.002	0.001		0.008
Frequency of use	Pearson correlation	0.118	0.045	0.208**	1
	Significance (double tail)	0.136	0.572	0.008	
Note: * * At 0. 01 level (double tail), the correlation is significant					

The calculation results of correlation coefficients of each variable show that among the independent variables, theoretical mastery, technical level and dependent variable proficiency are significantly correlated [5]. Among them, theoretical mastery is highly relevant. The mastery of theory can be understood as the subjective level, that is, the motivation of use. According to the theory of planned behavior (TPB), people's behavior is the result of careful consideration.

The mastery of information teaching theory and the renewal of ideas can promote teachers' in-depth understanding of education information action and become the driving force of behavior [6]. However, the application and improvement of specific information technology depend on actual behavior, that is, the level of technology application at the practical level. The correlation coefficient between technical level and proficiency is slightly lower than that of theoretical mastery, so there may be problems such as insufficient theory transformation and practice, and mismatch between information technology practice and teaching theory updating in the current information teaching process of teachers.

In the three-dimensional correlation analysis of independent variables, technical level is significantly correlated with the other two dimensions, and theoretical mastery and technical level can promote each other; The frequency of use can also improve the technical level. The correlation between the frequency of use and theoretical mastery is weak, which indicates that although teachers use IT teaching frequently, they may only make simple PPT, and have not designed or improved the IT teaching process in depth.

This also shows that in terms of improving teachers' informatization teaching ability, it is necessary to mobilize teachers' enthusiasm for informatization teaching and strengthen teachers' information technology application level.

5 ANALYSIS ON THE PATH OF IMPROVING COLLEGE TEACHERS' INFORMATIZATION TEACHING ABILITY

Teachers' informatization teaching ability is a concentrated reflection of multiple influencing factors. The improvement of teachers' informatization teaching ability in colleges and universities is the result of the joint action of "self driving" and "school driving". The research results of "management status quo" also show that it is necessary to explore the development path of the joint role of schools and teachers. Therefore, based on the research content of "management status quo", we design the path to improve the informatization teaching ability of college teachers.

In the analysis of the path of information teaching ability improvement, the traditional regression method mainly explores the effect of single factor, and it is difficult to break through the pattern of multiple coexistence of influencing factors. The qualitative comparative analysis method (QCA) has the advantage in studying the driving force of the coexistence of multiple influencing factors by analyzing the necessary conditions for a certain result to measure the impact of different cause combinations on the results. This method can systematically analyze.

With small sample data, it is found that the configuration relationship between multiple factors and the "joint effect" of multiple concurrent factors on the outcome variables will help researchers to deepen their systematic understanding of the research samples. The analysis of multiple influencing factors also shows that the mastery of teaching theory and the application level of information technology cannot be the necessary conditions for the improvement of information teaching ability alone. Therefore, the QCA method is used to analyze the combination of secondary variables to explore the internal mechanism and path of ability development.

The basic analysis logic of QCA method is as follows: variable design, variable assignment, necessary condition detection and condition combination detection. Among them, variables generally include outcome variables and explanatory variables; The value is divided into 0 and 1 according to the case scenario. The occurrence scenario is 1, and the non occurrence scenario is 0. The reference indicators are "consistency" and "coverage": "consistency" refers to the extent to which the necessary conditions of design are shared by all cases in a specific result; "Coverage" is the explanatory power of the necessary condition to the results. The higher the indicator value, the higher the explanatory power.

5.1 Variable design and detection

According to the questionnaire design, the informatization teaching proficiency is recorded as a "result variable", and "whether to participate in the informatization teaching related training", "whether to conduct teaching reflection and improve", "whether the school attaches importance to the informatization teaching", "whether the school formulates a development plan for informatization teaching", "whether to share resources on the network" are recorded as "explanatory variables". See Table 5 for the code design and assignment.

Table 5 Code assignment table of result variable and explanatory variable

Variable Type	variable	Assigned to 1	Assigned to 0
Result variable assigned to 1	Informatization proficiency (SLCD)	"Generally skilled" and above	"Generally skilled" and below
	Attend relevant training (XGPX)	Y	N
Explanatory variable	Whether teaching reflection (JXFS")	Y	N
Explanatory variable	School emphasis (ZSCD)	"Attach importance" and "attach great importance"	"General" and "Not attached"
	School development planning (FZGH)	Y	N
	Network resource sharing (ZYFX)	be willing	unwilling

Relevant variables were analyzed by the qualitative comparative analysis software fs/QCA3.0. First, the necessary conditions of the single explanatory variable to the result variable are tested. The purpose of necessary condition detection is to verify whether there is only a single

condition that can lead to the result. It is judged by whether the "consistency" is greater than 0.9. If the consistency of variables exceeds 0.9, it can be considered as a necessary condition; Otherwise, it can be seen from Table 6 that the consistency of a single explanatory variable is less than 0.9, indicating that each explanatory variable is not sufficient to constitute a necessary condition for the application proficiency of information technology means. The development of teachers' information teaching ability is the result of the joint action of many factors, which requires the analysis of the combination of explanatory variables.

Table 6 Single explanatory variable necessary

	Consistency	Coverage
XGPX	0.3928	0.2558
JXFS	0.2321	0.2600
ZSCD	0.6964	0.4333
FZGH	0.6250	0.4118
ZYFX	0.5892	0.3235
Notes: outcome = SLCD		

The principle of variable combination necessary condition detection is the same as that of single explanatory variable detection. Based on the consistency analysis results of different combinations of variables, Table 7 selects three pairs of combinations with consistency higher than 0.9 and high coverage among many combinations, which can effectively explain the development path of information teaching ability.

Table 7 Analysis results of combination of explanatory variables

	Raw coverage	Unique coverage	Solution coverage	Consistency
FZGH+ZSCD +XGPX+ZYFX	0.4615	0.4615	1	0.9821
XGPX+JXFS +ZSCD+ZYFX	0.2727	0.2622	1	0.9524
JXFS+FZGH+ZYFX	0.1667	0.1667	1	0.9207

Three valid combinations of explanatory variables can be obtained from Table 7. Based on the combination of three pairs of explanatory variables, we can sort out three paths to improve teachers' informatization teaching ability as follows:

Combination I: FZGH+ZSCD+XGPX+ZYFX;

Combination II: XGPX+JXFS+ZSCD+ZYFX;

Combination III: JXFS+FZGH+ZYFX.

5.1.1 External force driven: development planning+emphasis+related training+resource sharing

"Development planning+emphasis" belongs to the explanatory variable "related training" in "school management". It is also a way to achieve self improvement by means of external drive. "Resource sharing" takes the network platform as the carrier to exchange and share massive

information. Therefore, this path is an external force driven lifting path. Self determination theory believes that when learning needs are met by social environment or activities, learners will interact constructively with the learning environment, thus producing high-quality input.

In order to effectively improve teachers' information teaching ability, international efforts are very important. The United States has carried out five "National Education Technology Plans" from 1996 to 2015, aiming to improve teachers' information teaching ability; In 1988, the UK issued the ability standard for teachers to apply information technology. In the following years, it also stipulated the professional quality, skills, knowledge and understanding that teachers in the UK must have in the process of using information technology in the 21st century. In recent years, China has actively promoted the implementation of the integrated training of network research and school-based research to improve teachers' informatization teaching ability. Therefore, colleges and universities are actively developing education informatization, providing teachers with support from smart classroom construction, information platform construction, teaching APP design and other links, and at the same time, investing funds to train teachers' information teaching level. These measures have deepened teachers' understanding of ICT in education, and their own learning needs have also been met, effectively promoting the improvement of teachers' IT based teaching ability.

5.1.2 Internally driven: related training+teaching reflection+emphasis+resource sharing

The combination path is mainly based on "self-management". Internal factors are the driving force for the development of things. Teachers have also said in the survey: "Informatization teaching has put forward higher requirements for teachers, and new content must be added to the classroom." Such recognition urges teachers to constantly reflect on teaching, enrich the classroom and actively participate in various trainings.

Human behavior will be affected by the interaction of environment, behavior and individual. The subjective evaluation of an individual's ability to complete a certain aspect of work will directly affect his/her behavioral motivation. The process of "teaching reflection" is also a process of self-evaluation. Analyzing the deficiencies in the teaching process through teaching effects, student feedback and other links "participating in training" is a means to improve teaching ability. The explanatory variable of "self-management" is actually a typical manifestation of self-efficacy. The school's emphasis has created a good environment for teachers to improve themselves, and network resources are a tool for improvement. The internally driven development path achieves the goal of developing teachers' informatization teaching ability through the interaction between self-assessment and the environment.

5.1.3 Expectation driven: teaching reflection+development planning+resource sharing

In the expectation theory, incentive force=expectation value X potency, "teaching reflection" is to put forward higher requirements for their own teaching ability, constantly pursue the renewal of teaching methods, and expect low "development plan" can be regarded as potency. The development plan formulated by the school provides guidance for teachers' development, and encourages teachers to define their own target value.

To sum up, "resource sharing" is the overlapping element of the three paths, and network resources have become an important way to improve learning. A technology acceptance model

is proposed for the use behavior of information systems. It believes that information sharing is a very important feature in action, which can increase the exchange of experiences between people, open up new areas for personal knowledge, and retain some important information [7][8]. At this stage, various forms of teaching methods and resources such as Moke, micro class and SPOC are constantly applied to the teaching process, and the importance of the network as a media carrier is increasingly recognized by teachers.

6 CONCLUSION

The existing research on teachers' informatization teaching ability mainly focuses on the impact of informatization teaching on the curriculum, and reflects the current situation of informatization teaching ability through descriptive statistics of survey data. Teachers' information-based teaching ability is the result of the joint action of comprehensive influencing factors. How to break through the multiple patterns of influencing factors of teachers' information-based teaching ability and explore its improvement path is the central issue of promoting the implementation of education informationization and realizing the integration and transformation of education innovation. On the basis of previous studies and in combination with the process of investigation and demonstration, teachers' informatization teaching ability is regarded as the combination of theoretical understanding and teaching practice. Through the QCA analysis of the influencing factors of informatization teaching ability, we explore the path to improve informatization teaching ability, and form the following exploratory conclusions.

6.1 The development logic of university teachers' informatization teaching ability presenting drive response strengthening cycle

With the development of science and technology, and the continuous innovation of educational concepts, the connotation of educational informatization is constantly enriched. As the implementer of educational informatization, teachers' professional development of informatization has become a major constraint factor. The research shows that the information-based teaching theory can help teachers to formulate teaching objectives and evaluation systems scientifically, form effective information-based teaching design, and become the driving force to improve the information-based teaching ability[9]. At the same time, with the continuous development of information technology hardware and the continuous improvement of the education information environment, the application of related technologies has facilitated the in-depth development of information based teaching and encouraged teachers to constantly improve their information based teaching ability. The frequency of the use of information teaching will urge the repeated correction of the teaching process and play a role in prompting the improvement of information teaching ability. On the whole, teachers' information teaching process can be seen as a drive response strengthening cycle.

6.2 The information-based teaching ability of college teachers is affected by such factors as theoretical mastery and technical level

Based on behaviorism learning theory, this paper puts forward the circular development logic that information teaching theory, application level of information teaching technology and

frequency of information technology means affect information teaching ability. Through the survey of college teachers, it is found that the mastery of teaching theory is significantly related to the informatization teaching ability, followed by the technical level and frequency of use[10]. Therefore, the current informatization teaching process of teachers may only be the reuse of simple courseware, and there is no in-depth informatization teaching design and improvement of informatization teaching process. The practical transformation ability is insufficient, and the informatization teaching ability needs to be effectively improved.

6.3 College teachers can improve their information-based teaching ability through three paths: external force driving, internal driving and expectation driving

The improvement of teachers' information-based teaching ability is the result of the joint action of many factors. Based on the QCA analysis of the survey results of college teachers, it was found that participation in training, teaching reflection, the degree of emphasis of the school, the school's information-based development planning and resource network sharing could not be the necessary conditions to improve teachers' information-based teaching ability alone. Then, the combination of variables was analyzed to explore the internal mechanism and path of ability development. The analysis results show that the development of teachers' informatization teaching ability is the result of the combination of multiple variables, which can be generalized into three development paths, namely, external force driven, internal driven and expectation driven external force driven, which mainly emphasizes that when learners' learning needs are met by the surrounding environment, high-quality input will be generated; The internal drive is to achieve the goal of developing teachers' informatization teaching ability through the interaction between self-assessment and environment; Expectation driven motivation is based on individual expectation and potency.

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