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Article

Analysis of the Correlation between Teachers' Digital Competence Construction and Basic Education Quality Improvement Based on Adaptive Algorithm

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Abstract: The digital transformation of education is an important strategic choice for building a high-quality development education system in the new era, and the digital transformation of basic education is inevitable in line with the development of the times. This paper explores the impact of teachers' digital competence on the quality of basic education from the dimension of teachers' competence. Teachers' digital teaching ability is divided into four dimensions: teaching design ability, teaching organization and implementation ability, teaching management and evaluation ability, and teaching development ability, and the level of teachers' digital teaching development is investigated. By establishing an adaptive multiple linear regression model, the correlation analysis between the development level of teachers' digital teaching ability and the quality of basic education, and the linear regression analysis, the relationship between teachers' digital teaching ability and the quality of basic education was obtained. The model R^2 value of the adaptive multiple linear regression model is 0.833, and the model passes the F test. It indicates that at least one of digital instructional design competencies, organizational and implementation competencies, management and evaluation competencies, developmental competencies, and digital pedagogical literacy will have an impact on the quality of basic education.

Keywords: digital competence; linear regression; multiple linear regression; quality of basic education

1. Introduction

Innovation is the eternal theme of university development, and teachers, as the main body of innovation in universities, face the need to redefine their roles, professional skills and teaching methods [1-2]. Especially in the field of digital teaching, the innovation ability of teachers is particularly critical, which is not only directly related to the improvement of education quality, but also an important guarantee for the realization of the overall development of students [3-5]. The integration of digital technology into teaching not only meets the changes in educational needs and improves the quality and efficiency of education, but also greatly promotes the overall development of students and prepares them to adapt to the future society [6-7].

At the same time, the enhancement of teachers' digital teaching ability will also promote the innovation and improvement of teaching practice, the sharing and collaboration of educational resources, and the construction of a more open and flexible educational ecosystem [8-9]. However, despite the great attention paid to this in the education sector, teachers still face many challenges in the process of developing this competency [10]. In the face of the deep-rooted traditional educational concepts, inflexible assessment systems, lack of teachers' personal competence and psychological support, and rapid changes in the technological environment, a series of educational change measures need to be taken in order to effectively enhance teachers' digital teaching competence and promote the process of educational modernization [11-12]. Based on this, exploring the relationship between teachers' digital



teaching competence related to the quality of basic education aims to provide useful reference and guidance for educational reform.

In this paper, linear regression analysis method is proposed, and model building and model testing are carried out for multiple linear regression method. Combined with the adaptive algorithm, the adaptive multiple linear regression model is proposed, and each parameter of its regression equation is obtained through the established adaptive multiple linear regression model, and the adaptive parameters are solved. Teachers' digital teaching ability and the quality of basic education are taken as the independent variables and dependent variables of the linear regression equation respectively to analyze the relationship between teachers' digital teaching ability and the quality of basic education. The research was conducted to understand teachers' digital teaching ability, and the digital ability was constructed from 4 dimensions. Adaptive multiple linear regression model was established, and correlation analysis and linear regression analysis were carried out sequentially to derive the actual variables of the relationship.

2. Presentation of the Methodology

2.1. Presentation of the Regression Analysis Method

Linear regression has many practical uses. There are two main categories: Linear regression can be used to fit a prediction model from the values of the observed dataset and X if the goal is prediction or mapping. When such a model is completed, a y value can be predicted using the fitted model for a new X value without a y pairing with it.

Given a variable y and a number of variables X_1, X_2, \dots, X_p , these variables are likely to be related to y , linear regression analysis can be used to quantify the strength of the correlation between y and X , to assess X that is not related to y , and to identify which subsets of X contain redundant information about y .

2.1.1. Multiple Linear Regression

Multiple regression analysis is a statistical analysis method in which one variable is considered as the dependent variable and one or more other variables are considered as independent variables in the correlation, a mathematical model quantitative equation of linear or non-linear relationship between multiple variables is established and analyzed using sample data. Also to be discussed is the multiple regression analysis of linear dependence of multiple independent variables on multiple dependent variables called multiple multiple regression analysis model. Usually there are more than one factors affecting the dependent variable and this problem of multiple independent variables affecting one dependent variable can be solved by multiple multiple regression analysis. In linear regression analysis, multiple linear regression has greater practical significance than univariate linear regression [13-15].

The basic tasks of multiple linear regression analysis are as follows: establish multiple linear regression equations of the dependent variable on multiple independent variables based on the actual observed values of the dependent variable and numerous independent variables. Evaluating the relative importance of the effect of each independent variable on the dependent variable as well as determining the height of the bias of the optimal multiple linear regression linear equation. Many multivariate nonlinear regression problems can be solved by multivariate linear regression, so multivariate linear regression has a wide range of applications.

2.1.2. Multiple Linear Regression Models

Let there be the following linearity between the variable Y and the variables X_1, X_2, \dots, X_p :

$$Y = \beta_0 + \beta_1 X_1 + \dots + \beta_p X_p + \varepsilon \quad (1)$$

where β_0 is the regression constant and $\beta_1, \beta_2, \dots, \beta_p$ are the overall regression parameters. When $p = 1$, Equation (1) is said to be a one-dimensional linear regression model. When $p \geq 2$, call it a multiple linear regression model. The ε is the random error and obeys the $\varepsilon \sim N(0, \sigma^2)$ distribution.

The parameter β is most commonly estimated by least squares estimation (OLS) with an objective function of minimization:

$$Q(\beta) = \sum_{i=1}^n \|y_i - x_i \beta\|^2 \quad (2)$$

Since the matrix $X'X$ is usually singular when solving real problems. So when $X'X$ is a non-singular matrix, it indicates that the variables are not perfectly correlated with each other, and the least squares estimate obtained in this case is:

$$\hat{\beta} = (XX)^{-1} XY \quad (3)$$

The regression model can thus be obtained as:

$$\hat{Y} = X \hat{\beta} = X(X'X)^{-1} X'Y \quad (4)$$

2.1.3. Tests of Multiple Linear Regression Models

From the established multiple linear regression model and the regression coefficients that have been obtained, to test the fit of the entire regression equation, the R^2 test can be used.

The coefficient of determination R^2 is defined as:

$$R^2 = 1 - \frac{SSE}{SST} \quad (5)$$

where SSR denotes the regression sum of squares, which is defined as in Equation (5), and reflects the portion of the change in y due to the linear relationship between x and y . SST denotes the sum of squares of total deviations, which is defined as in Equation (6), and reflects the total deviation of the n observations of the dependent variable from its mean value. SSE denotes the sum of squares of residuals, which is defined as in equation (7), and reflects the role of factors other than the linear effect of x on y on y variation, and is the portion of variation in y that cannot be accounted for by regression straight lines. That is, there is:

$$SSR = \sum_{i=1}^n (\hat{y}_i - \bar{y})^2 \quad (6)$$

$$SST = \sum_{i=1}^n (y_i - \bar{y})^2 \quad (7)$$

$$SSE = \sum_{i=1}^n (y_i - \hat{y}_i)^2 \quad (8)$$

The relationship between the three is satisfied:

$$SST = SSR + SSE \quad (9)$$

R^2 reflects the goodness of fit of the regression line to the data and takes values between $[0, 1]$. The fact that R^2 tends to be closer to 1 indicates that the regression equation is better fitted, and conversely, the fact that R^2 tends to be closer to 0 indicates that the regression equation is worse fitted.

2.2. Adaptive Multiple Linear Regression Models

The multiple linear regression equation can be expressed as:

$$E(y) = a_1 + a_2 x_1 + a_3 x_2 + \dots + a_p x_p \quad (10)$$

The above equation represents the relationship between the mathematical expectation of dependent variable y and independent variable x_1, x_2, \dots, x_p .

When using $\hat{a}_1, \hat{a}_2, \dots, \hat{a}_p$ estimate the unknown parameters in the multiple linear regression equation, the estimated multiple linear regression equation can be obtained:

$$\hat{y} = \hat{a}_1 + \hat{a}_2 x_1 + \dots + \hat{a}_p x_p \quad (11)$$

In Eq. $\hat{a}_1, \hat{a}_2, \dots, \hat{a}_p$ is the estimate of parameter a_1, a_2, \dots, a_p , \hat{y} is the estimate of dependent variable y , and $\hat{a}_1, \hat{a}_2, \dots, \hat{a}_p$ is called the regression coefficient. That is, there is:

$$y_i = a_1 + a_2 x_{i1} + a_3 x_{i2} + \dots + a_p x_{ip} + \varepsilon_i \quad (12)$$

Multiple linear regression is the use of least squares estimation to find an estimate of the unknown parameter a_1, a_2, \dots, a_p based on the correlation between multiple independent variables and a dependent variable. That is, there are:

$$Q = \sum_{i=1}^n [y_i - (a_1 + a_2 x_{i1} + a_3 x_{i2} + \dots + a_p x_{ip})]^2 \quad (13)$$

Since Q is a function about a_1, a_2, \dots, a_p , the problem translates into solving for the minimum of a multivariate function, and the least squares estimate is the solution to the following system of equations:

$$\begin{bmatrix} l_{11}a_2 + l_{12}a_3 + \dots + l_{1p}a_p = L_{1y} \\ l_{21}a_2 + l_{22}a_3 + \dots + l_{2p}a_p = L_{2y} \\ \dots \\ l_{p1}a_2 + l_{p2}a_3 + \dots + l_{pp}a_p = L_{py} \\ a_1 = \bar{y} - a_2\bar{x} + a_3\bar{x}_2 + \dots + a_p\bar{x}_p \end{bmatrix} \quad (14)$$

where the system of regular equations can be expressed as:

$$\begin{bmatrix} \bar{y} = \frac{1}{n} \sum_{i=1}^n y_i, \bar{x}_k = \frac{1}{n} \sum_{i=1}^n x_{ik} (k = 1 \dots p) \\ |L_{kj} = \frac{1}{n} \sum_{i=1}^n (x_{ik} - \bar{x}_k)(x_{ij} - \bar{x}_j) = L_{jk} (k, j = 1 \dots p)| \\ L_{ky} = \frac{1}{n} \sum_{i=1}^n (x_{ik} - \bar{x}_k)(y_i - \bar{y}) (k = 1 \dots p) \end{bmatrix} \quad (15)$$

When L^* is invertible, the system of regular equations has a solution:

$$\begin{pmatrix} \hat{a}_2 \\ \vdots \\ \hat{a}_p \end{pmatrix} = L^{*-1} \begin{pmatrix} L_{1y} \\ \vdots \\ L_{py} \end{pmatrix}, a_1 = \bar{y} - \hat{a}_2\bar{x}_1 - \dots - \hat{a}_p\bar{x}_p \quad (16)$$

The multiple linear regression equation can be obtained:

$$\hat{y} = \hat{a}_1 + \hat{a}_2 x_1 + \dots + \hat{a}_p x_p \quad (17)$$

Or solve for the minimum value of Q by taking a partial derivative of the following system of equations. i.e., there is:

$$\left\{ \begin{array}{l} \frac{\partial Q}{\partial a_1} = 0 \\ \frac{\partial Q}{\partial a_2} = 0 \\ \dots \\ \frac{\partial Q}{\partial a_p} = 0 \end{array} \right. \quad (18)$$

In order to solve the adaptive multiple linear regression equation, the least squares method is used to estimate the parameters to minimize the residual sum of squares. That is, there are:

$$Q = \sum_{i=1}^n \varepsilon_i^2 = \sum_{i=1}^n [y_i - (a_1 + a_2x_{i1} + a_3x_{i2} + \dots + a_9x_{i8})]^2 \quad (19)$$

By Q for a_1, a_2, \dots, a_p to find the partial differential quotient such that it satisfies the following system of equations:

$$\left\{ \begin{array}{l} \frac{\partial Q}{\partial a_1} = -2 \sum_{i=1}^n (y_i - a_1 - a_2x_{i1} - a_3x_{i2} \dots - a_9x_{i8}) = 0 \\ \frac{\partial Q}{\partial a_2} = -2 \sum_{i=1}^n (y_i - a_1 - a_2x_{i1} - a_3x_{i2} \dots - a_9x_{i8})x_{i1} = 0 \\ \frac{\partial Q}{\partial a_3} = -2 \sum_{i=1}^n (y_i - a_1 - a_2x_{i1} - a_3x_{i2} \dots - a_9x_{i8})x_{i2} = 0 \\ \dots \\ \frac{\partial Q}{\partial a_9} = -2 \sum_{i=1}^n (y_i - a_1 - a_2x_{i1} - a_3x_{i2} - \dots - a_9x_{i8})x_{i8} = 0 \end{array} \right. \quad (20)$$

The estimate of a is obtained by solving the above system of equations:

$$X\hat{a} = Y \quad (21)$$

Simultaneous left multiplication of both sides by X^T gives:

$$(X^T X)\hat{a} = X^T Y \quad (22)$$

when the coefficient matrix:

$$A = X^T X \quad (23)$$

are invertible matrices when there:

$$\hat{a} = (X^T X)^{-1} X^T Y \quad (24)$$

With x_1, x_2, \dots, x_8 as the independent variables and y as the dependent variable, i.e., the mathematical model of adaptive multiple linear regression is as follows:

$$y = a_1 + a_2x_1 + a_3x_2 + \dots + a_9x_8 + \varepsilon \quad (25)$$

The mathematical expectation for y , denoted \hat{y} , yields the adaptive multiple linear regression equation for the theory as:

$$\hat{y} = a_1 + a_2x_1 + a_3x_2 + \dots + a_9x_8 \quad (26)$$

After substituting the variables, the following system of equations is obtained:

$$\begin{cases} y_1 = a_1 + a_2x_{11} + a_3x_{12} + \dots + a_9x_{18} + \varepsilon_1 \\ y_2 = a_1 + a_2x_{21} + a_3x_{22} + \dots + a_9x_{28} + \varepsilon_2 \\ \vdots \\ y_n = a_1 + a_2x_{n1} + a_3x_{n2} + \dots + a_9x_{n8} + \varepsilon_n \end{cases} \quad (27)$$

Express the above system of equations in matrix form as:

$$Y = \begin{bmatrix} y_1 \\ y_2 \\ \vdots \\ y_n \end{bmatrix} \quad X = \begin{bmatrix} 1 & x_{11} & x_{12} & \dots & x_{18} \\ 1 & x_{21} & x_{22} & \dots & x_{28} \\ \vdots & \vdots & \vdots & \vdots & \vdots \\ 1 & x_{n1} & x_{n2} & \dots & x_{n8} \end{bmatrix} \quad (28)$$

$$A = \begin{bmatrix} a_1 \\ a_2 \\ \vdots \\ a_9 \end{bmatrix} \quad \varepsilon = \begin{bmatrix} \varepsilon_0 \\ \varepsilon_1 \\ \vdots \\ \varepsilon_n \end{bmatrix} \quad (29)$$

To wit:

$$Y = XA + \varepsilon \quad (30)$$

The adaptive multiple linear regression equation is obtained by substituting \hat{a} into the above equation.

Through the established adaptive multiple linear regression model to obtain its regression equation each parameter is shown in Table 1. The required multiple regression equation is basically consistent with the expression established by adaptive parameter solving.

The indicators for testing the adaptive multiple linear regression model mainly include R^2 (correlation coefficient) and the probability of significance p value. The closer the correlation coefficient is to 1, the more significant the adaptive multiple linear regression equation is, the smaller the probability p (between 0.01 and 0.05) is, and the smaller the residual variance is. When $p < \alpha = 0.05$, the regression model holds.

Table 1. Adaptive multivariate linear regression equation.

Regression equation parameter	a_1	a_2	a_3	a_4	a_5	a_6	a_7	a_8	a_9
Numerical value	0.12	-0.85	0.10	1.93×10^{-3}	12.06	-1.04	0.96	-40.21	4.52

2.3. Model Variables

2.3.1. Teachers' Capacity to Teach Digitally

“Digital pedagogical competence” emphasizes that ‘the use of digital technology is not a simple combination of technology and teaching, but rather an integrated innovation of technology and teaching for complex learning environments’. Therefore, it can be considered that teachers' digital teaching competence refers to their ability to use digital technology and resources for teaching design, teaching implementation, teaching evaluation and teaching management in a digital teaching environment. Specifically, this competence is mainly composed of 4 aspects of competence:

(1) Digital teaching design ability. Teachers are able to select and use digital teaching resources reasonably according to the teaching objectives and students' characteristics, and design a teaching program in line with students' cognitive laws, including the digital presentation of teaching content, the

design of teaching activities and the planning of teaching processes.

(2) Digital teaching implementation ability. Teachers are proficient in the use of digital teaching tools and platforms, and are able to flexibly use multimedia, online teaching platforms, virtual simulation software and other means to carry out teaching activities, and realize the interactivity, interestingness and efficiency of classroom teaching.

(3) Digital teaching evaluation ability. Teachers are able to use digital means to conduct comprehensive, objective and accurate evaluation of students' learning process and learning effect, such as through online testing, learning data analysis, etc., to understand students' learning situation in a timely manner, and provide a basis for teaching adjustment.

(4) Digital teaching management ability. Teachers have the ability to manage teaching resources, teaching process and teaching team by using digital technology, including the classification, organization and sharing of teaching resources, the arrangement and monitoring of teaching progress, and the collaboration and communication of teaching team.

2.3.2. Basic Education

(1) The strategic position and important role of basic education

The special significance of basic education can be understood from three aspects: from the viewpoint of national development, it is necessary to fully understand that basic education plays an important role in laying the foundation for the realization of great renaissance.

From the viewpoint of the public's expectations, it is important to fully realize that basic education is a major livelihood project that increases the people's sense of gain and happiness. Basic education is geared to every family and every person, and is related to the healthy growth of hundreds of millions of children, as well as the happiness and harmony of every family.

From the perspective of education itself, it is important to fully understand the important and fundamental role of basic education in building a strong educational country and realizing the modernization of education. Without the modernization of basic education, it is impossible to have the modernization of the whole education, and the construction of a strong education country starts with the construction of a strong basic education country.

(2) The value of the era of digital transformation of basic education

The digital transformation of basic education is leading the wave of educational change of the times, and its value of the times has been highlighted. This transformation not only breaks the boundaries of time and space, realizes the extensive sharing of high-quality educational resources, and opens a new chapter of educational equity. It also profoundly reshapes the role of teachers, opening up new paths for their professional growth. At the same time, digitalization empowers the change of students' learning styles, promotes the vigorous development of independent learning and collaborative learning, and lays a solid foundation for students' lifelong learning. Especially important is that the personalized and customized learning model relies on advanced technology to customize the learning path for each student, stimulate learning potential, and promote international educational cooperation and cultural exchanges, opening up a new chapter for the construction of a more open, diversified and inclusive education ecology.

In the wave of digitization of basic education, the role of teachers has undergone a profound transformation. They have morphed beyond the role of mere knowledge transmitters to become mentors who lead students in exploration, designers of teaching strategies, and partners in the problem-solving process. This transformation requires teachers to continuously improve their digital literacy, master modern teaching techniques, and innovate teaching methods to adapt to the needs of digital teaching. At the same time, digitalization also provides new opportunities for teachers' professional growth. Through web-based training and online community seminars, teachers can continuously learn and communicate to improve their professionalism and teaching ability.

2.4. *Quality Improvement of Basic Education and Teacher Capacity Development*

Teaching quality is an important factor in the quality assurance of education, and teachers are not only the transmitters of knowledge, but also the shapers of students' values. The enhancement of their professionalism and innovation ability plays a crucial role in improving the quality of education and cultivating students with an innovative spirit.

First, professional training for teachers should be strengthened to enhance their educational and teaching abilities. By organizing various educational training courses, seminars and academic exchange activities, teachers should be enabled to update their educational concepts, master new teaching methods and means, and improve their teaching effectiveness.

Secondly, teachers should be encouraged to carry out educational research and improve their

scientific research ability and sense of innovation. Teachers with a certain degree of scientific research ability can better explore the laws of education, innovate educational models, and promote educational reform and development.

Third, emphasis should be placed on teachers' burden reduction and mental health. Most basic education schools do not have a dedicated administrative post to deal with non-educational matters in the classroom. Teachers often have to be responsible for both teaching and administrative affairs, which makes their work more stressful and makes them prone to burnout and psychological problems.

Schools should reduce the burden of non-teaching affairs on teachers, and at the same time establish a sound mechanism for teachers' mental health counseling, provide teachers with psychological support and assistance, so that teachers can maintain a good state of mind and a positive mental outlook, and enhance teachers' sense of professional identity and happiness. At the same time, teachers should be provided with broad space for development and promotion opportunities, and their enthusiasm for work and creative ability should be stimulated through the establishment of teachers' growth files and the development of the "Master Teacher Project", among other initiatives.

3. Relevance Analysis

3.1. General Status of Teachers' Digital Teaching Competence

(1) Research Methods and Research Tools

The method of questionnaire survey was adopted, and a total of 412 questionnaires were issued and recovered through questionnaire star, with 398 valid questionnaires and 96.6% effective rate.

The questionnaire is divided into four parts. The first part is a survey of the basic information of teachers, including gender, age, educational background, teaching experience, professional title, etc. The second part is the investigation of teachers' digital teaching ability, using the method of Likert five-level scale, the teacher's digital teaching ability is divided into 4 first-level indicators and 17 second-level indicators, each second-level index is divided into "never used - beginning to understand - preliminary application - integration - innovation" 5 different levels of level, positive scoring, the score is 1~5 points, the higher the score indicates the higher the level of teachers' digital teaching ability. The third part is a survey of the influencing factors of teachers' digital teaching ability, using the method of ranking questions. The fourth part is an open-ended question "What else do you want to say about improving teachers' digital teaching capabilities, please write down", mainly to understand teachers' opinions or suggestions. In addition, in-depth interviews were conducted with some teachers, and qualitative analysis of the interview results was conducted.

(2) Research Subjects

Of the 15 Chongqing schools surveyed, 3 were kindergartens, 4 each were elementary, middle and high schools.

(3) Research results and analysis

The overall situation of teachers' digital teaching ability is shown in Table 2. From the results of the survey, the overall mean value of teachers' digital teaching competence in basic education is 3.75, which is less than 4. It indicates that the overall development level of teachers' digital teaching competence in basic education in Chongqing is currently at a medium level. As can be seen from the table, the mean values of the four first-level indicators are, in descending order, digital teaching development ability, digital teaching management and evaluation ability, digital teaching design ability and implementation ability, and digital teaching development ability.

Table 2. The general situation of the teacher's digital teaching ability.

Primary indicator	Mean	Secondary indicator	Mean
Digital teaching design ability	3.72	Digital affective ability	3.59
		Digital resource building capacity	3.76
		Digital teaching activities design ability	3.84
		The ability of mixed learning space design	3.69
Digital teaching group to weave and implement ability	3.71	Learning organization construction ability	3.75
		Digital learning ability	3.60
		Digital communication ability	3.92
		Digital teaching innovation ability	3.58
Digital teaching management and evaluation ability	3.76	Ability to use digital teaching platform	3.74
		Learning data mining ability	3.53
		Student data analysis ability	3.91
		Digital teaching feedback ability	3.86

Digital teaching development ability	3.81	Digital teaching reflection ability	3.67
		Digital professional learning ability	3.84
		Digital teaching ability	3.93
		Digital teaching leadership	3.85
		Digital collaborative ability	3.76

The difference analysis of digital teaching competence of teachers with different professional backgrounds is shown in Table 3.

The independent samples t-test on the digital teaching competence of teachers with different professional backgrounds reveals that there are significant differences between teachers graduated from teacher training majors and non-teacher training majors in digital teaching design competence, digital teaching organization and implementation competence, and digital teaching development competence, with a p-value of less than 0.05.

In terms of mean value, the mean score of digital instructional design competence of teachers graduated from teacher training program is 3.76, which is significantly higher than the digital instructional design competence of teachers graduated from non-teacher training program is 3.50.

The digital instructional design competence, digital instructional organization and implementation competence, digital instructional management and evaluation competence, and digital instructional development competence of teachers graduating from the teacher training program are higher than the digital instructional competence of teachers graduating from the non-teacher training program.

Table 3. The difference analysis of different teachers' digital teaching ability.

	Professional before entry	Average (standard deviation)	T	P
Digital teaching design ability	Normal major	3.756(0.554)	3.512	0.001**
	Non-normal major	3.501(0.891)	-	-
Digital teaching group to weave and implement ability	Normal major	3.899(0.748)	2.106	0.006**
	Non-normal major	3.425(0.655)	-	-
Digital teaching management and evaluation ability	Normal major	3.674(0.596)	3.001	0.003**
	Non-normal major	3.231(0.809)	-	-
Digital teaching development ability	Normal major	3.757(0.663)	3.202	0.021**
	Non-normal major	3.542(0.512)	-	-

3.2. Adaptive Multiple Linear Regression Modeling

A questionnaire was distributed among the student body of a school and students were asked to rate their performance against various aspects of the teacher's performance on a comprehensive scale (five-point scale).

The survey statistics on the quality of teachers' education are shown in Table 4, where y, x1, x2, x3, and x4 represent the overall quality of teachers' education, the rationality of the organization of the course content, the logic with which the main issues were carried out, the effectiveness in answering the students' questions, and the usefulness of the communication in the classroom, respectively.

Table 4. Teacher education quality survey statistics.

y	x1	x2	x3	x4
4.15	4.52	4.59	4.21	4.15
3.23	4.23	4.81	4.36	4.66
4.56	3.57	4.32	3.92	4.24
4.36	4.69	4.20	3.13	3.59

4.20	3.89	4.33	4.84	4.04
3.59	4.05	3.96	3.56	4.39
3.94	4.36	3.54	3.77	4.24
4.13	3.64	3.72	4.68	4.36
4.57	4.23	3.59	4.23	3.57
4.19	4.52	4.20	3.69	4.14
4.23	3.78	4.34	4.14	4.56
4.75	3.94	4.08	3.57	3.79
4.91	4.24	4.22	3.69	3.94
3.87	4.65	4.34	4.12	4.19
3.96	4.31	4.69	4.68	4.28

To perform adaptive multiple nonlinear regression fitting, the quadratic terms in the nonlinear regression terms are combined and transformed, resulting in data linearized by the data characterized by the quality of teacher education. Adaptive multiple linear regression analysis and adaptive multiple nonlinear regression analysis were performed based on the above data.

The adaptive multiple linear regression coefficients are shown in Table 5, and the value of R^2 is 0.893.

Table 5. Adaptive multivariate linear regression coefficient.

Variable	Intercept	x_1	x_2	x_3	x_4	R^2
Regression coefficient	-1.527	0.642	-0.095	0.842	0.074	0.893

The adaptive multiple nonlinear regression coefficients are shown in Table 6, with a R^2 value of 1.000.

Table 6. Adaptive multivariate nonlinear regression coefficient.

Variable	Intercept	x_1	x_2	x_3	x_4	x_5
Regression coefficient	0.542	-35.426	18.243	-10.223	-9.547	-5.643
Variable	x_6	x_7	x_8	x_9	x_{10}	R^2
Regression coefficient	-8.414	7.243	-3.546	-0.124	-0.124	1.000

From the multiple regression correlation coefficients in the above table, it can be seen that the nonlinear regression comparison model has a higher explanatory power, so the nonlinear regression model was chosen to fit the regression and obtain the regression equation.

3.3. Relationship between Teachers' Digital Competence and the Quality of Education

3.3.1. Correlation Analysis

The correlation between teachers' digital teaching ability and the quality of basic education is shown in Table 7.

There is a significant positive correlation between teachers' digital teaching competence and the quality of basic education, and the higher the score of teachers' digital teaching competence, the higher the score of the quality of basic education, which represents that there is a certain correlation between teachers' digital teaching competence and the quality of basic education.

In terms of specific dimensions, there is a positive correlation between teachers' digital teaching design competence, organization and implementation competence, management and evaluation competence, development competence and basic education quality.

There is a positive correlation between digital pedagogical literacy and basic education cognitive level, implementation level, evaluation ability, innovation ability, and education quality.

Table 7. The correlation between teacher's digital ability and education quality.

	Education cognitive level	Implementation level	Evaluation ability	Innovative ability	Education quality
Digital teaching literacy	0.626**	0.523**	0.693**	0.572**	0.636**
Teaching design ability	0.512**	0.552**	0.142**	0.569**	0.665**
Organization and implementation ability	0.365**	0.479**	0.436**	0.724**	0.543**
Management and evaluation ability	0.524**	0.521**	0.524**	0.663**	0.524**
Teaching development ability	0.712**	0.634**	0.432**	0.675**	0.757**

3.3.2. Linear Regression Analysis

The linear regression analysis of teachers' digital teaching competence and basic education quality is shown in Table 8.

Linear regression analysis was conducted with digital teaching design ability, organization and implementation ability, management and evaluation ability, development ability, and digital teaching literacy as the independent variables and basic education quality as the dependent variable. The model R^2 value of 0.833 represents that digital instructional design capacity, organizational and implementation capacity, management and evaluation capacity, developmental capacity, and digital pedagogical literacy explain 83.3% of the variation in instructional capacity. The model passes the F-test, indicating that at least one of digital instructional design competencies, organizational and implementation competencies, management and evaluation competencies, developmental competencies, and digital pedagogical literacy will have an impact on the quality of basic education.

Table 8. The linear regression analysis of teachers' digital ability and teaching quality.

	Nonnormalized coefficient		Normalization factor	t	P	Common linear statistics	R^2	Adjusted R^2	F
	B	Standard error	Beta						
(constant)	8.563	3.519		3.224	0.001	4.572	0.833	0.841	132.664 (0.00**)
Teaching design ability	1.271	0.563	0.367	3.055	0.005	3.481			
Organization and implementation ability	2.426	0.551	0.542	6.524	0.004	1.426			
Management and evaluation ability	2.735	0.439	0.296	6.012	0.003	2.669			
Teaching development ability	0.813	0.586	0.243	4.123	0.001	2.334			
Digital teaching literacy	1.469	0.671	0.554	4.775	0.000	3.679			

4. Conclusion

This paper utilizes adaptive multiple linear regression method to establish the relationship model between teachers' digital teaching ability and basic education quality. Investigating the overall development of teachers' digital teaching competence, dividing the dimension of digital teaching competence and the dimension of basic education quality, the relationship between teachers' digital teaching competence and the quality of basic education is explored by linear regression method. The overall mean value of teachers' digital teaching ability in basic education is 3.75, and the overall development of teachers' digital teaching ability is in the middle level. Teachers' digital teaching ability was related to whether they had a teacher training background, and teachers who graduated from teacher training were more likely to have higher digital teaching ability than teachers who did not graduate from

teacher training. Combined with the adaptive multiple linear regression method, it was obtained that teachers' digital ability was significantly correlated with the quality of basic education.

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