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Analyzing the role of preschool environment on children's psychological development based on big data technology

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Abstract The critical period of children's early psychological development determines their future cognitive abilities, social skills and emotion regulation levels. In this study, 1430 preschool children from eight kindergartens in Jiangsu Province were selected by whole cluster random sampling method, and data were collected by using the Classroom Environment Scale and the Overall Well-Being Scale, and the mechanism of preschool environment on children's psychological development was analyzed by combining multiple linear regression algorithms and big data techniques such as redundancy analysis (RDA). It was found that the intimacy of the preschool environment was significantly and positively correlated with children's social initiative, verbal and nonverbal interaction skills (P<0.01), and the standardized regression coefficient of the emotional expression dimension was 0.124 (P=0.01) and the standardized regression coefficient of the recreational dimension was 0.128 (P=0.023), which were both positively predictive of children's verbal and nonverbal interaction skills. RDA ordination analysis showed that the cumulative percentage of explanation of the first four axes for the relationship between children's psychological development and the preschool environment amounted to 99.88%, with the correlation coefficients of self-concept, family relationships, school hardware, and maskedness with the first axis being -0.4127, -0.366, -0.3272, and -0.3085, respectively. The study showed that several dimensions of the preschool environment had a has a significant effect, in which emotional expression and entertaining environment are important factors to promote the development of children's language interaction skills, and the study provides a scientific basis for optimizing the design of preschool education environment.

Index Terms Preschool environment, children's psychological development, big data technology, multiple linear regression, redundancy analysis, language interaction skills

I. Introduction

It has been reported that 21,000 children and adolescents under the age of 18 were found to have psychological problems and referred for treatment in the UK in 2022, a 46% increase from the previous year [1]. And in the 10 years prior to the New Crown outbreak, the number of adolescents with psychological problems and even suicidal thoughts and behaviors increased by about 40% in the U.S. [2]. Singaporean adolescents accounted for about 16% of those reporting low mood or anxiety among children and adolescents aged 4-21 years [3]. The issue of children's mental health has become a challenge and a common theme in countries around the world today.

Childhood is a critical stage of psychological development, and good mental health is essential for children's growth [4]. However, children's psychological problems are gradually increasing, including emotional problems, behavioral problems, and learning problems. Emotional problems are mainly manifested as anxiety, depression, irritability and so on. Behavioral problems are mainly manifested as aggressiveness, destructiveness, withdrawal, and so on. Learning problems are mainly manifested as inattention, learning difficulties, etc. The emergence of these problems stems from the role of various factors such as family, school, and society [5]-[7]. Among them, school occupies most of the children's time and covers the outlets for the emergence of psychological problems such as peer socialization, academic pressure, parental expectations, and self-confidence. Excessive parental academic expectations may cause children to develop problems such as anxiety, stress and boredom of learning, which not only affects their mental health, but may also directly lead to symptoms such as headache, insomnia and depression [8]-[10]. In addition, children may not have enough time or space to participate in extracurricular or social activities, which can negatively affect their emotional and social skills development [11], [12]. The current preschool environment is in a stage of rapid change, with the compression of space for educational activities, a gradual increase in digital interaction time, a relative decrease in offline socialization, and outdated management concepts that make it difficult to cope with the current problems of precociousness and cognitive overload in children [13]-[15]. In this context, children's psychological development changes are complex.

This study mainly adopts big data technology and statistical methods to systematically explore the law of the role of preschool education environment on children's psychological development by constructing scientific measurement tools and analysis models. Standardized scales were first used to collect large sample data to ensure the representativeness and generalizability of the research results. Then, multiple linear regression algorithms were used to analyze the predictive effects of each environmental dimension on children's psychological development indicators, and to quantify the strength of the influence of different factors. Finally, redundancy analysis (RDA) was applied to rank the ecological factors, identify the key influencing factors, and reveal the complex relationship between environment and psychological development. This multi-method combination of research paths can not only ensure the scientificity and accuracy of the data, but also provide specific guiding suggestions for educational practice and promote the overall improvement of preschool education quality.

II. Research Design

The rapid development of preschool education has also brought people's concern and discussion on various issues of preschool education, among which the influence and role of preschool education environment on children's psychological development has become a topic that cannot be ignored. In this paper, the role of preschool environment on children's psychological development will be analyzed by using big data technology.

II. A. Objects of study

In this study, the whole group random sampling method was used to select preschool children attending 8 kindergartens in Jiangsu Province, China as the research object, a total of 1483 questionnaires were distributed, and the questionnaires were recovered with the assistance of the kindergarten teachers, and 53 invalid questionnaires were directly deleted for the repetition of the same answer choices, and 1,430 valid questionnaires were finally sorted and selected to be used with an effective recovery rate of 96.43%.

II. B. Research tools

II. B. 1) Classroom environment scale

The classroom environment scale was based on the My Class questionnaire, with a total of 38 items, including five subscales: teacher-student relationship, peer relationship, order and discipline, competition and study load. Subjects were asked to give feedback on a five-point Likert scale ranging from 0-5 on a scale of “never” to “always”, which corresponded to their actual situation. The Cronbach's alpha coefficient of this scale in this study was 0.936, which has good measurement performance.

II. B. 2) General well-being scale

The General Well-Being Scale (GWBS) is a self-report scale consisting of 33 questions designed to measure the psychological development of children. It consists of six factors: satisfaction and interest in life, health concerns, energy, depressed or happy state of mind, control over emotions and behavior, relaxation and tension. In general, higher outcome scores represent higher levels of subjective well-being. The Cronbach's alpha coefficient of this scale in this study was 0.826, which has good reliability and validity.

II. C. Data processing

The study used scientific statistical software SPSS 26.0 to process and analyze the data. The main statistical methods such as descriptive statistics, one-way ANOVA, correlation analysis, linear regression analysis, and multilayer linear analysis were performed to analyze and process the data [16].

II. D. Research methodology

The main research method used in this study is the multiple linear regression algorithm [17].

It is assumed that the prediction object Y is affected by multiple independent variables $X_1, X_2, ..., X_p$, and assuming that the relationship between each independent variable and Y is linearly correlated, the multiple regression model is established as:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \cdots + \beta_p X_p + \varepsilon \tag{1}$$

In the above equation β_0 is a constant term, $\beta_1, \beta_2, ..., \beta_p$ are the partial regression coefficients and ε is the random error.

The above equation is the theoretical regression model, and for the n sets of actual data collected, the multiple linear regression model can be expressed as:

$$\begin{cases} Y_1 = \beta_0 + \beta_1 X_{11} + \beta_2 X_{12} + \ldots + \beta_P X_{1P} + \varepsilon \\ Y_2 = \beta_0 + \beta_1 X_{21} + \beta_2 X_{22} + \ldots + \beta_P X_{2P} + \varepsilon \\ \vdots \\ Y_n = \beta_0 + \beta_1 X_{n1} + \beta_2 X_{n2} + \ldots + \beta_P X_{nP} + \varepsilon \end{cases} \tag{2}$$

is written as a matrix of the form $Y = X\beta + \varepsilon$, where:

$$X = \begin{bmatrix} 1 & X_{11} & X_{12} & \cdots & X_{1P} \\ 1 & X_{21} & X_{22} & \cdots & X_{2P} \\ \vdots & \vdots & \vdots & \vdots & \vdots \\ 1 & X_{n1} & X_{n2} & \cdots & X_{nP} \end{bmatrix} \quad Y = \begin{bmatrix} Y_1 \\ Y_2 \\ \vdots \\ Y_n \end{bmatrix} \quad \varepsilon = \begin{bmatrix} \varepsilon_1 \\ \varepsilon_2 \\ \vdots \\ \varepsilon_n \end{bmatrix} \quad \beta = \begin{bmatrix} \beta_1 \\ \beta_2 \\ \vdots \\ \beta_n \end{bmatrix} \tag{3}$$

The matrix X is a regression design matrix or information matrix, i.e. the elements of X are predetermined and can be controlled. In fact, the connection between anything is basically multifaceted, and changes in one dependent variable are often influenced by multiple other independent variables. The meta-linear regression is a generalization of the univariate linear regression, compared with the univariate linear regression with a single independent variable, the multiple linear regression not only has more than one independent variable, but also has a linear relationship between multiple independent variables. In actual load forecasting, forecasting with only one independent variable is often not realistic. On the contrary, the optimal linear combination of multiple independent variables to predict the load value fits the reality and is more effective.

1) Parameter estimation of multiple linear regression models

The unknown parameter solution is consistent with that of the univariate linear regression model, where a set of parameter estimates $\beta_0^{'}, \beta_1^{'}, \beta_2^{'}, ..., \beta_p^{'}$ such that the sum of squared deviations of the residual terms is minimized.

$$Q(\beta_0^{'}, \beta_1^{'}, \cdots, \beta_p^{'}) = \sum_{i=1}^{n} (Y_i - \beta_0 - \beta_1 X_1 - \cdots - \beta_p X_p)^2 \tag{4}$$

According to the advanced mathematics multivariable calculus in the extreme value of the method of the unknown parameters of the above formula for the partial derivatives and make the partial derivatives equal to 0, the specific solution method is as follows:

$$\begin{cases} \dfrac{\partial Q}{\partial \beta_0} = -2\sum_{i=1}^{n} (Y_i - \beta_0 - \beta_1 X_{i1} - \cdots - \beta_p X_{ip}) = 0 \\ \dfrac{\partial Q}{\partial \beta_1} = -2\sum_{i=1}^{n} (Y_i - \beta_0 - \beta_1 X_{i1} - \cdots - \beta_p X_{ip}) X_{i1} = 0 \\ \vdots \\ \dfrac{\partial Q}{\partial \beta_p} = -2\sum_{i=1}^{n} (Y_i - \beta_0 - \beta_1 X_{i1} - \cdots - \beta_p X_{ip}) X_{ip} = 0 \end{cases} \tag{5}$$

The system of equations is solved for the estimated value $\beta_0^{'}, \beta_1^{'}, \beta_2^{'}, \cdots, \beta_p^{'}$, not its true value, so the system of equations can be simplified to:

$$\begin{cases} n\beta_0^{'} + (\sum_{i=1}^{n} X_{i1})\beta_1^{'} + (\sum_{i=1}^{n} X_{i2})\beta_2^{'} + \cdots + (\sum_{i=1}^{n} X_{ip})\beta_p^{'} = \sum_{i=1}^{n} Y_i \\ (\sum_{i=1}^{n} X_{i1})\beta_0^{'} + (\sum_{i=1}^{n} X_{i1}^2)\beta_1^{'} + (\sum_{i=1}^{n} X_{i1}X_{i2})\beta_2^{'} + \cdots + (\sum_{i=1}^{n} X_{i1}X_{ip})\beta_p^{'} = \sum_{i=1}^{n} X_{i1}Y_i \\ \vdots \\ (\sum_{i=1}^{n} X_{ip})\beta_0^{'} + (\sum_{i=1}^{n} X_{ip}X_{i1})\beta_1^{'} + (\sum_{i=1}^{n} X_{ip}X_{i2})\beta_2^{'} + \cdots + (\sum_{i=1}^{n} X_{ip}^2)\beta_p^{'} = \sum_{i=1}^{n} X_{ip}Y_i \end{cases} \tag{6}$$

Call this system of equations a regular system of equations. It is easy to prove that:

$$X^{'}X=\begin{bmatrix} n & \sum_{i=1}^{n}X_{i1} & \cdots & \sum_{i=1}^{n}X_{ip} \\ \sum_{i=1}^{n}X_{i1} & \sum_{i=1}^{n}X_{i1}^{2} & \cdots & \sum_{i=1}^{n}X_{i1}X_{ip} \\ \vdots & \vdots & \ddots & \vdots \\ \sum_{i=1}^{n}X_{ip} & \sum_{i=1}^{n}X_{ip}X_{i1} & \cdots & \sum_{i=1}^{n}X_{ip}^{2} \end{bmatrix} \tag{7}$$

$$X^{'}Y=\begin{bmatrix} 1 & 1 & \cdots & 1 \\ X_{11} & X_{21} & \cdots & X_{n1} \\ \vdots & \vdots & \vdots & \vdots \\ X_{1p} & X_{2p} & \cdots & X_{np} \end{bmatrix}\begin{bmatrix} Y_1 \\ Y_2 \\ \vdots \\ Y_n \end{bmatrix} \tag{8}$$

Let the vector of estimates of the matrix of regression coefficients β be β', so that the corresponding matrix form of the system of equations is:

$$X^{'}X\beta^{'}=X^{'}Y \tag{9}$$

When $(X^{'}X)^{-1}$ exists, the least squares estimator can be obtained as:

$$\beta^{'}=(X^{'}X)^{-1}X^{'}Y \tag{10}$$

2) Basic Assumptions of Multiple Linear Regression Models

In a regression model, parameter estimation and obtaining high quality estimates requires basic assumptions about the regression equation similar to those that are made in analyzing the monolinear regression method:

(1) The independent variables are deterministic and the matrix X is full rank.

(2) The expected value of the random error is zero, i.e., there is no systematic error in the observations; the covariance of the random error is zero, i.e., there is no correlation between different sample points.

(3) The random error is normally distributed.

(4) The variances of the random errors are equal, i.e., they have homoscedasticity.

(5) The regression equation is free of setting bias, i.e., the model is correctly set up.

(6) There is no high degree of covariance between the respective variables X, i.e. there is no multicollinearity.

3) Multivariate linear regression model heteroskedasticity

The multiple linear regression model is said to have heteroskedasticity if the variance of the random errors is not an invariant constant. It can be expressed as $Var[\varepsilon_i]=\sigma_i$ or:

$$Var[\varepsilon]=E[\varepsilon\varepsilon^{'}]=\begin{bmatrix} \sigma_1^2 & & & \\ & \sigma_2^2 & & \\ & & \ddots & \\ & & & \sigma_n^2 \end{bmatrix} \tag{11}$$

It is difficult to maintain the variance of the random error as a constant in the actual load forecast, and often when the scatter plot of its variance and the independent variable is located in a fixed region, it is considered that the heteroskedasticity is eliminated or the influence is extremely small. And the width of the region determines the degree of influence, the smaller the domain width, the smaller the degree of fluctuation of the variance of ε_i, the smaller the influence of heteroskedasticity. However, due to the small sample of medium-term load forecasting, the heteroskedasticity is often not taken into account, which leads to unsatisfactory application of regression equations, poor prediction accuracy and other defects. Therefore, how to shorten the domain width to reduce the effect of heteroskedasticity is the key to improve the prediction accuracy. At present, there are four common heteroskedasticity test methods as follows:

(1) Residual plot analysis method

Residual plot analysis is one of the clearest and most intuitive methods, generally using the dependent variable as the horizontal coordinate, using the estimate of random error e or e^2 as the vertical coordinate, tracing out the residuals scatterplot to determine whether there is correlation. The steps of plotting are to first calculate the residual series based on the regression equation, and then plot the scatterplot with the residual series and the dependent variable.

(2)Breusch-Pagan test

The test is set to assume a linear function:

$$\varepsilon^2=\delta_0+\delta_1X_1+\delta_2X_2+\cdots+\delta_kX_k+v \tag{12}$$

Step1: Ignore heteroskedasticity and directly find the least squares regression.

Step2: Calculate its residuals ε_i and residuals squared using the resulting regression equation.

Step3: Use the explanatory variables of the original model as a regression and note down the squared coefficient of determination R_{c2}^2 for this regression.

Step4: Test the null hypothesis is:

$$H_0 : \delta_1 = \delta_2 = \cdots = \delta_k = 0 \tag{13}$$

Perform an F test, or a Lagrange multiplier test:

$$LM = nR_{\varepsilon^2}{}^2 \sim \chi_k{}^2 \tag{14}$$

(3) Golisle test

Step1: By fitting a regression model between the absolute value of the residual ε and the independent variable X_j:

$$|\varepsilon| = \alpha + \delta X_j^l + v \tag{15}$$

Depending on the distribution of the graph choose l =1, -1 or 0.5.

Step2: Then test the null hypothesis $\beta = 0$ (no heteroskedasticity). If the null hypothesis is not true or is rejected, the regression equation is considered to have heteroskedasticity.

(4) White's Test.

As an example, the regression model of two independent variables, this regression model is shown in equation (16):

$$Y_i = B_0 + B_1 X_{1i} + B_2 X_{2i} + \varepsilon_i \tag{16}$$

Step1: Do an auxiliary regression by finding the regression equation based on the OLS method (17):

$$\varepsilon_i^2 = A_0 + A_1 X_{1i} + A_2 X_{2i} + A_3 X_{1i}^2 + A_4 X_{2i}^2 + A_6 X_{1i} X_{2i} + v_i \tag{17}$$

Step2: Find the squared value of the coefficient of determination of the auxiliary regression equation, i.e., the R^2 value. Under the null hypothesis, use White's method to prove that the product of the R^2 value and the sample size n obtained from equation (17) obeys a chi-square distribution. This is shown in equation (18):

$$nR^2 \sim \chi^2 \tag{18}$$

Step3: Based on the magnitude of the value of statistic nR^2, compare it with the chosen level of significance to see if the null hypothesis is accepted.

III. Analysis of the role of preschool environment on children's psychological development

In this chapter, correlation analysis and regression analysis will be carried out on the role of preschool environment on children's psychological development, and RDA ranking of factors influencing children's psychological development will be conducted to explore the relationship between preschool environment and children's psychological development.

III. A. Analysis of the relevance of the preschool environment to children's psychological development

The correlations between preschool environment and children's psychological development are specifically shown in Table 1. The proximity of the preschool environment showed a significant positive correlation with children's social initiative, verbal and nonverbal interaction skills ($p<0.01$). The emotional expression dimension of the preschool environment showed a significant positive correlation ($P<0.01$) with children's social initiative, verbal and nonverbal interaction skills, pro-social behavior, and social impairment. This suggests that in creating a good preschool environment for children to develop good peer interactions, it is important for children to feel safe in a preschool environment that accepts all sides of the child, and that they can be their truest selves without worrying about what others think of them.

The ambivalence dimension in the preschool environment was significantly and negatively correlated with children's verbal and nonverbal interaction skills, and pro-social behavior ($p<0.01$). The results of this study suggest that the higher the level of open expression of anger, aggression, and ambivalence among educational members, the poorer the development of children's verbal and nonverbal interaction skills, and pro-social behavior. This reminds educators to control themselves as much as possible in front of children, to start fewer arguments and to create an emotionally stable and calm environment for children.

Intellectual dimensions of the family environment are significantly and positively correlated with children's social initiative, verbal and nonverbal interaction skills, and pro-social behavior ($p<0.01$). This suggests that for the more politically, socially, intellectually and culturally active atmosphere of the preschool environment, the more social initiative, better verbal and non-verbal interaction skills, and pro-social behavior of children.

The recreational dimension of the preschool environment was significantly and positively correlated with children's social initiative, verbal and nonverbal interaction skills, and pro-social behavior ($p<0.01$). Educators should organize more classroom-based recreational activities, thus enhancing relationships among students and promoting the development of children's peer interaction skills.

The dimension of ethical and religious views in the preschool environment was significantly and positively correlated with children's pro-social behavior ($r=0.118$, $P<0.01$). This indicates that the higher the emphasis on ethics and morality in the preschool environment, the more pro-social behavior of children. This may be due to the fact that children have more pro-social behaviors because of the educators' focus on teaching them ethics.

Organizational nature of the preschool environment was significantly and positively correlated with children's social initiative, verbal and non-verbal interaction skills, pro-social behavior, and social impairment ($p<0.01$). Significant positive correlations between organization and the four dimensions of peer interaction skills indicate that the more planned and orderly the preschool environment is, the better the children's social initiative, verbal and nonverbal interaction skills, pro-social behaviors, and social barriers are.

The controlling dimension of the preschool environment was significantly and positively correlated with children's social initiative, verbal and nonverbal interaction skills, and pro-social behavior ($p<0.01$). It indicates that children who grow up in preschool environments with high levels of clear requirements and rules for doing things in their daily lives develop better social initiative, verbal and nonverbal interaction skills, and pro-social behavior.

Table 1: Preschool education environment and children 's psychological development

-	Social initiative	Language and non-language communication skills	Prosocial behaviour	Social barriers
Intimacy	0.169***	0.199***	0.171**	0.137**
Emotional expression	0.148	0.188***	0.128**	0.133**
Contradiction	-0.078	-0.132**	-0.149**	-0.051
Independence	0.038	0.061	0.052	-0.008
Success	0.096	0.072	0.089	0.063
Knowledgeability	0.118**	0.222***	0.194***	0.054
Entertainment	0.179***	0.213***	0.17**	0.071
Moral religion view	0.063	0.028	0.118*	-0.061
Organizationality	0.117**	0.176***	0.15**	0.099*
Controllability	0.108*	0.132**	0.129**	0.056

III. B. Regression analysis of preschool environment on children's psychological development

1) Regression analysis of preschool environment on children's verbal and nonverbal interaction skills

The regression coefficients of preschool education environment on children's verbal and nonverbal interaction skills are specifically shown in Table 2. The following results can be drawn from the table.

(1) The multivariate correlation coefficient between preschool environment and young children's verbal and nonverbal interaction skills is 0.328, and the coefficient of determination R2 is 0.112, which indicates that the ten dimensions (predictor variables) of preschool environment explain a total of 11.2% of the variance in young children's verbal and nonverbal interaction skills.

(2) And no significance level was reached on intimacy, ambivalence, independence, success, knowledge, moral-religious outlook, organization, and control of the preschool environment, indicating that these eight variables explain very little of the variance in young children's verbal and nonverbal interaction skills.

(3) The standardized regression coefficient for the emotional expression dimension of the preschool environment was 0.124 ($P=0.01<0.05$), indicating that emotional expression positively predicts young children's verbal and nonverbal interaction skills. The standardized regression coefficient for the entertainment dimension of the preschool environment was 0.128 ($P=0.023<0.05$), indicating that entertainment positively predicts young children's verbal and nonverbal interaction skills.

Table 2: Regression analysis

-	B	Standard error	Beta	T	P
(Constant)	3.006	0.313	0.006	-	0.004
Intimacy	0.032	0.021	0.042	0.849	0.385
Emotional expression	0.042	0.022	0.124	2.375	0.01
Contradiction	-0.027	0.015	-0.057	-1.194	0.238

Independence	0.008	0.023	0.019	0.405	0.69
Success	0.023	0.026	0.038	0.726	0.459
Knowledgeability	0.022	0.026	0.068	1.137	0.254
Entertainment	0.035	0.023	0.128	2.296	0.023
Moral religion view	-0.025	0.027	-0.034	-0.832	0.401
Organizationality	0.028	0.019	0.061	1.009	0.314
Controllability	0.006	0.016	0.048	0.774	0.454
R=0.328	R2=0.112	After adjustment R2=0.082	F=4.686***		

2) Regression analysis of preschool environment on children's social impairment

The results of regression coefficients of preschool education environment on children's social disorder are specifically shown in Table 3. It can be seen that the multivariate correlation coefficient between preschool environment and children's social impairment is 0.224, and the coefficient of determination R2 is 0.055, which indicates that the ten dimensions (predictor variables) of preschool environment can explain a total of 5.5% of the variance of children's social impairment. In contrast, no significance level was reached on intimacy, ambivalence, independence, success, knowledge, recreation, organization, and control of the preschool environment, indicating that these eight variables explain very little of the variance in children's social impairment. The standardized regression coefficient for the affective expression dimension of the preschool environment was 0.104 ($p=0.028<0.05$), indicating that affective expression positively predicts children's social impairment. The higher the level of emotional expression in the preschool environment, the higher the children's social impairment score, i.e., the lower the children's social impairment. The standardized regression coefficient for the moral-religious outlook dimension of the preschool environment was -0.098 ($p=0.015<0.05$), indicating that moral-religious outlook negatively predicted children's social impairment. The higher the moral-religious outlook in the preschool environment, the lower the children's social impairment scores, i.e., the lower the children's social impairment.

Tabel 3: Regression analysis of preschool education environment on social barriers

-	B	Standard error	Beta	T	P
(Constant)	3.117	0.36	-	8.622	-0.008
Intimacy	0.025	0.036	0.062	0.958	0.329
Emotional expression	0.043	0.03	0.104	2.189	0.028
Contradiction	-0.005	0.024	-0.03	-0.38	0.698
Independence	-0.018	0.038	-0.041	-0.774	0.434
Success	0.041	0.021	0.064	1.333	0.18
Knowledgeability	-0.003	0.031	-0.003	-0.091	0.921
Entertainment	0.016	0.015	0.026	0.516	0.601
Moral religion view	-0.059	0.028	-0.098	-2.1	0.015
Organizationality	0.041	0.02	0.057	1.14	0.266
Controllability	0.001	0.016	0.008	0.13	0.891
R=0.224	R2=0.055	After adjustment R2=0.082	F=1.862***		

III. C. Ranking of RDA key influences on children's psychological development

Ecological factors are all environmental factors that have a direct or indirect effect on the growth, development, reproduction, behavior and distribution of organisms. Quantitative classification and ranking is an important quantitative method to study the ecological relationship of plant communities. Currently, the commonly used sorting methods are principal component analysis-based (PCA) and correspondence analysis (CA)-based nonlinear sorting methods have a wide range of applications in ecological research. DCA sorting was first performed on the research subjects, and the results of this study showed that the first axis gradient length 0.39<3SD linear model-based sorting method is more suitable. In this paper, we use redundancy analysis RDA to rank the influencing factors of left-behind children's psychological capital, and the ranking method is used CANOCO4.5 software [18].

The RDA ranking of children's psychological development, the ranking results are specifically shown in Table 4. The eigenvalues of the first four axes were 0.3618, 0.0058, 0.0018, and 0.0014, respectively, and the Monte Carlo fitting test for the first and first four axes showed that there was a significant correlation between the preschool environment variables represented by both the first and first four axes and the psychological development variables (first axis: F=368, p=0.004; first four axes: F=22.4, p= 0.004), and preschool environmental factors had a significant

effect on children's psychological development. The cumulative percentage of explanation of the first four axes on the relationship of children's psychological development - preschool education environment is 99.88%, of which the cumulative percentage of explanation of the first two axes is 99.01%, which contains larger ecological information and shows important ecological significance, so the two-dimensional ordination diagrams made by using the first and the second ordering axes can well respond to the The mechanism of educational ecology on psychological capital.

Table 4: RDA ranking

-	RDA			
Project	First axis	Second axis	Third Axis	Fourth axis
Eigenvalue	0.3618	0.0058	0.0018	0.0014
Correlation between species and environment	0.6466	0.3282	0.2714	0.2391
Cumulative contribution rate of species variance	36.52	36.96	37.1	37.25
Cumulative contribution rate of species-environment relationship variance	98.05	99.01	99.47	99.88
Monte Carlo fitting test 1	F=368,P=0.004	-	-	-
Monte Carlo fitting test	F=22.4,P=0.004			

The correlation coefficients between the environmental factors and the RDA sorting axes are specifically shown in Table 5.

Table 5: The relationship between environmental factors and RDA ordination axis

Variables	First axis	Second axis
Age	0.1191	0.1416
Grade	0.1174	0.097
Gender	0.0212	0.0925
Inward and outward leaning	-0.3009	0.1363
Neuroticism	0.1964	0.0176
Psychoticism	0.096	0.1377
Concealment	-0.3085	0.0009
Self-cognition	-0.4127	-0.1359
Emotional experience	-0.2467	0.0275
Coping style	-0.2305	0.0097
Daily care	-0.2223	-0.1063
Economic status	-0.1212	0.0162
Family relations	-0.366	-0.044
Family communication	-0.2217	-0.0427
The teacher encourages	-0.27	0.0207
The teacher cares	-0.2466	0.0238
Classmate relationship	-0.1238	0.0392
School software	-0.2849	-0.0632
School hardware	-0.3272	-0.1299

The RDA ranking of children's psychological development was plotted as shown in Figure 1. The preschool environmental factors are represented by arrows, and the length of the arrow connecting line indicates the magnitude of the influence of the preschool environmental factor on the research subject, and the longer the connecting line, the greater the influence of this preschool environmental factor on the research subject. The slope of the line of the arrow indicates the correlation between the preschool environmental factor and the sorting axis, so the smaller the slope and the smaller the angle, the higher the correlation, and the quadrant in which the arrow is located indicates the positive or negative correlation between the preschool environmental factor and the sorting axis.

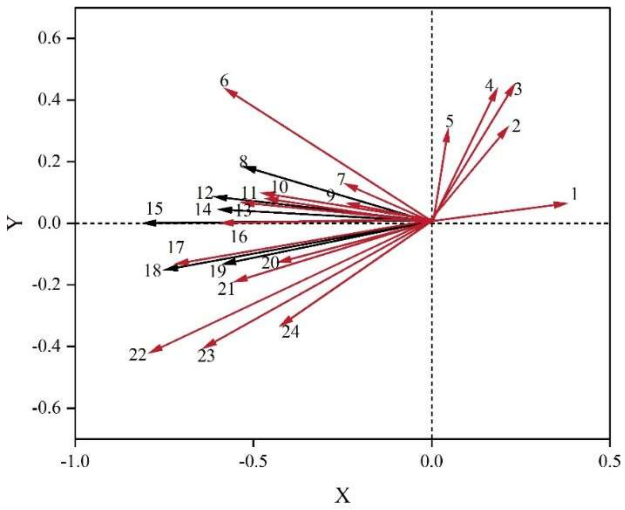

Figure 1: RDA two-dimensional ordering

The child psychological development factors represented by the numbers 1 to 24 in the above figure are specifically shown in Table 6.

Table 6: Numbering of children 's psychological development factors

Number	Factor	Number	Factor
1	Neuroticism	13	The teacher cares
2	Grade	14	Self-reliance tenacious
3	Age	15	Coping style
4	Psychoticism	16	Concealment
5	Gender	17	Family relations
6	Inward and outward	18	Confident and enterprising
7	Peer relationship	19	Ming Li Thanksgiving
8	Optimistic and cheerful	20	Family communication
9	Economic status	21	Software environment
10	The teacher encourages	22	Self-cognition
11	Emotional experience	23	Hardware environment
12	Tolerant and friendly	24	Daily care

Combining the above table of correlation coefficients between environmental factors and RDA sorting axes with the RDA sorting diagram of children's psychological development, it can be seen that: the first axis of RDA mainly reflects the comprehensive change trends of self-perception and internal and external inclination in the individual's internal environment, family relationships in the family environment, and school hardware in the school environment: self-perception, family relationships, school hardware, and masking were significantly negatively correlated with the first axis (- 0.4127, -0.366, -0.3272, -0.3085) along the first axis from left to right, self-perception changed from positive to negative, masking increased, and family relations and school hardware gradually changed from good to bad. Among the 4 factors, self-perception has the highest correlation with the first axis. The second axis of the RDA mainly reflects the combined trend of self-perception, school hardware, and daily care: self-perception, school hardware, and daily care are negatively correlated with the second axis (-0.1359, -0.1299, and -0.1063), which indicates that along the second axis from the bottom to the top, self-perception gradually changes from positive to negative, school hardware environment satisfaction gradually decreases, and daily care gradually becomes worse.

From the figure, it can be seen that there are obvious differences in the influence of each educational environment factor on the psychological capital of left-behind children. Among them, self-perception, family relationship, school hardware and school software play the biggest role in left-behind children's psychological capital. In addition, teachers' encouragement and concern, positive coping, daily care, emotional experience, and peer relationship all have different degrees of influence on left-behind children's psychological capital, suggesting that psychological capital is the result of the joint action of multiple factors. However, age and mental quality show that the correlation is not significant.

IV. Conclusion

In this paper, the multidimensional influence mechanism of preschool education environment on children's psychological development was deeply analyzed through a large-scale survey study of 1430 preschool children. The results of data analysis show that there are significant correlations and predictive effects between preschool education environment and children's psychological development. In terms of verbal and nonverbal interaction skill development, the ten dimensions of preschool environment explained a total of 11.2% of the variance, with the emotional expression and recreational dimensions playing a key role. Analyses in social impairment revealed that the preschool environment dimensions explained 5.5% of the variance, and the standardized regression coefficient for the moral-religious outlook dimension was -0.098 (p=0.015), which was a significant negative predictor of reducing children's social impairment.

The results of the redundancy analysis further revealed the hierarchy of influence of the environmental factors, with the cumulative percentage of explanation of the first two axes reaching 99.01%, which fully reflected the mechanism of the educational ecological environment on psychological development. Among the key influencing factors, the correlation between the self-perception factor and the first axis is the strongest, indicating that the internal environment of the individual has a fundamental influence on children's psychological development. External factors such as school hardware and software environment, family relationship, and teacher care also play an important role, reflecting the multi-factor synergistic effect of psychological development.

Based on the results of the empirical analysis, preschools should focus on the creation of an environment for emotional expression and the design of recreational activities, and create an educational environment more conducive to children's psychological development by optimizing the quality of teacher-student interactions, enriching the forms of teaching activities, and perfecting the configuration of hardware and facilities, so as to promote their all-round development.

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