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Analysis of the Factors Which Influence the Academic Performance of Students and Regression Prediction Based on Multiple Linear Regression

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Student performance is the most direct reflection of students' academic levels, and it is influenced by many factors. In this study, we analyzed the factors affecting students' performance from three perspectives, school, family and individual based on several assumptions, we established an analysis index system, and obtained data through interviews and questionnaires for regression analysis. The results show that the three factors have a positive impact on students' performance, with school having the largest impact and family, the smallest. School quality had the most significant impact on students' performance. School atmosphere had a weak influence. Family, parents' educational level and parents' occupation had a large impact on students' performance. Family income had a small impact. In relation to individual aspects, responsibility had the highest influence, followed by psychological state and living habits. The performance of students can be predicted according to the regression analysis results. This work provides a basis for education workers to improve student performance.

Keywords: multiple linear regression, student achievement, influencing factors, regression prediction

1. INTRODUCTION

Education plays an important role in social development, and a person's level of education is one of the criteria by which to measure individual ability. Academic performance is one way to measure a student's ability. A study of education involves many aspects such as pedagogy, psychology, sociology and so on, which has profound theoretical and practical value. Current studies have found that the participation of parents (Wang and Sheikhkhalil, 2014), school resources (Chowa et al., 2015), school leaders (Ten Bruggencate et al., 2013), number of children in the family (Roli and Stracqualursi, 2014), school safety (Kraft et al., 2016), parenting style (Zhang et al., 2014), teaching mode (Tian, 2021) and other factors may have an impact on students' performance. The research focuses on four aspects: family, school, individual and society. Family background determines the quality of education students have the opportunity to access, to some extent. The quality of schools is reflected in the allocation of education resources. An individual's psychological state will affect their enthusiasm to learn. The educational

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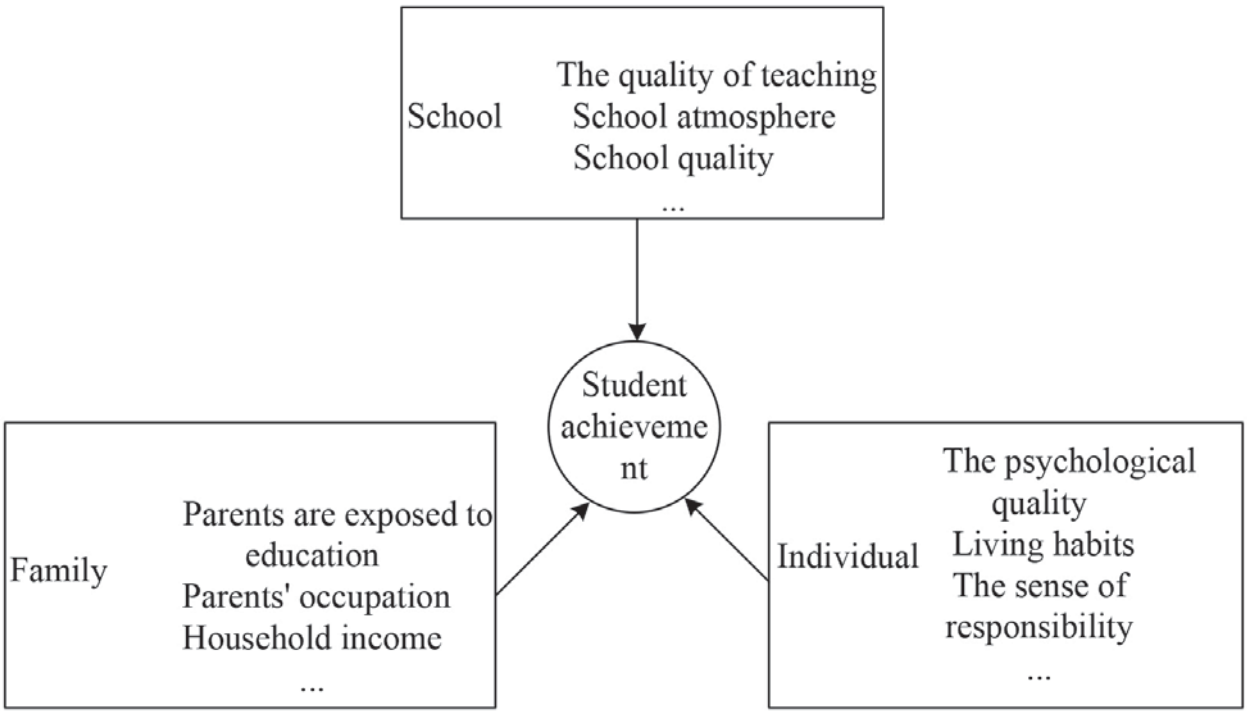

Figure 1 The factors influencing students' grades.

orientation of society has an important relationship with student learning. Studies of the four factors have been extended. Ochwo et al. (2013) studied the factors which influence the mathematics and English scores of grade 7 students in Uganda. Rasch analysis, covariance analysis and hierarchical linear modeling analysis found that teacher quality has a significant impact on student performance, and boarding and non-boarding, and school types (urban and rural) can also result in differences in student performance. Takashiro (2015) found that the education score of parents and the number of computers and books they own are positively correlated with students' math scores through the multi-level analysis of Japanese students' scores. Students in schools with a small population and poor economic status tend to have poor scores. Vigdor (2014) examined the impact of computers and found that the introduction of home computer technology has a lasting negative impact on students' performance in mathematics and reading, and the provision of home computers further widens the gap in students' performance. Qu et al. (2021) studied the factors which influence the English learning outcomes of college students and using descriptive statistical analysis and Pearson correlation analysis, found that a positive classroom environment can improve students' English proficiency and classroom participation, and that student responsibility and student cooperation were highly correlated with students' English learning outcomes. This paper discusses the influence of school, family and individual factors on students' performance and selects indicators from these three aspects for regression analysis to better understand the impact of various factors on students' performance and it also suggests ways to improve students' performance.

2. THE INFLUENCING FACTORS AND HYPOTHESES ON STUDENTS' GRADES

The factors which influence student achievement can be considered from three aspects: school, family and individual. Several factors comprise each aspect (Figure 1), which may have a positive or negative impact on students' performance.

Based on these factors, several hypotheses can be proposed:

(1) School factors can affect a student's grades.

A. The quality of teachers' teaching can affect students' grades.

B. The overall atmosphere of the school can affect students' performance.

C. The quality of the school can affect students' grades.

(2) Family factors can affect a student's grades.

A. Parents' education level can affect students' grades.

B. Parents' occupations can affect students' grades.

C. The level of family income can affect students' grades.

(3) Individual factors can affect students' grades

A. A student's psychological state will affect their performance.

B. The quality of individual living habits can affect students' grades

Table 1 Student performance analysis indicators.

Variable	Symbol	Indicators
The dependent variable	Y	Student achievement
The school	A1	The quality of teaching
	A2	School atmosphere
	A3	School quality
The family	B1	Parents' education
	B2	Parents' occupation
	B3	Household income
The individual	C1	Psychological state
	C2	Living habits
	C3	The sense of responsibility

C. The level of individual responsibility can affect students' performance.

This paper examines these hypotheses using regression analysis.

3. SELECTION OF ANALYSIS INDICATORS

Students' scores, that is, their total scores for the three courses of English and Chinese, were used as the dependent variable.

The student performance analysis indicators are shown in Table 1.

4. COLLECTION AND SORTING OF THE DATA

4.1 Research Subjects

Three middle schools were randomly selected from all middle schools in Hubei, and then four classes of students were randomly selected from the first grade of each middle school. The research subjects were 426 students.

4.2 Data Collection

Data were collected using interviews and questionnaires.

The students' scores were calculated from a possible total score of 360 by adding their final exam score for the three courses of English, English and Chinese.

Information about schools was obtained through the interviews with the education bureau, teachers and parents to assess the school's teaching quality, atmosphere and overall school quality.

Family and individual data were collected in the form of questionnaires. The content of the questionnaire included students' general information and a self-assessment of their psychological state, living habits and sense of responsibility.

4.3 Data Processing

(1) Teaching quality is divided into four categories: excellent, good, average and poor.

(2) The school atmosphere is divided into three categories: good, average and bad.

(3) School quality is divided into three categories: good, average and poor.

(4) Parent education is divided into college and above (3 points), high school and technical secondary school (2 points), and junior high school (1 point). The education level of parents is considered high if they score 5–6 points, average if they score 3–4 points, and low if they score 2 points.

(5) Parent's occupation is divided into: (1) managers in charge of an organisation or institution (5 points); (2) ordinary employees in an organisation or institution (4 points); (3) professional and technical personnel (3 points); (4) self-employed entrepreneurs, labourers and peasants; and (5) unemployed (1 point). A parent's occupation is considered good if they score 8–10 points, average if they score 5–7 points, and bad if they score 2–4 points.

(6) Family income: (1) high income (annual income of more than 100,000 yuan); (2) medium income (annual income: 60,000 to 100,000 yuan); (3) low income (annual income less than 60,000 yuan).

(7) Psychological state is divided into three categories: good, average and poor.

(8) Life habits are divided into three categories: good, average and poor.

(9) Sense of responsibility is divided into three categories: high, average and low.

A total of 426 questionnaires were issued, 412 questionnaires were received, and 8 invalid questionnaires were removed. Therefore, a total of 404 complete questionnaires were obtained. Two questionnaires were eliminated because the scores of two students were missing, so the final sample size was 402, comprising 198 male students and 204 female

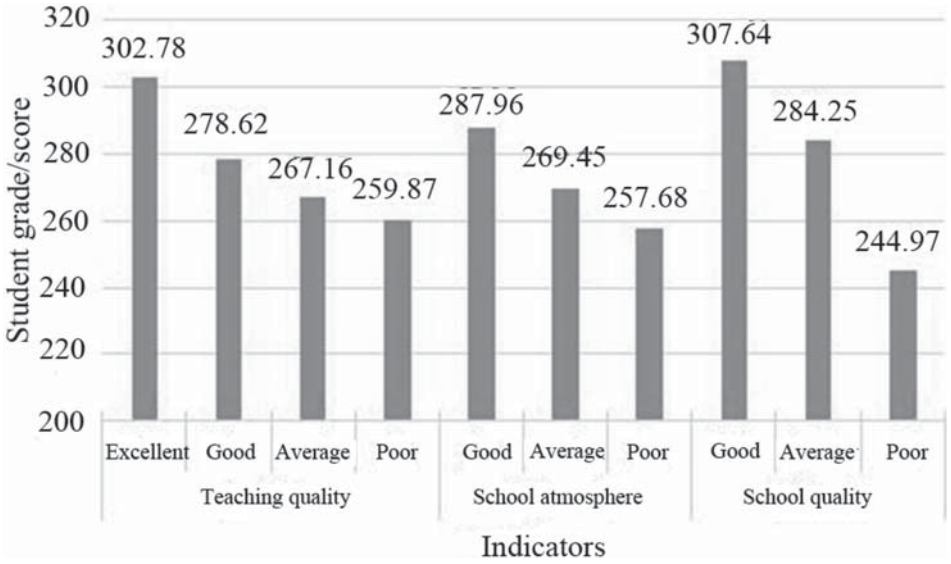

Figure 2 School factors and student average scores.

Table 2 School factors and student scores.

Indicators		Maximum value	Minimum value	Average	Standard deviation
The quality of teaching	Excellent	349	201	302.78	32.56
	Good	349	189	278.62	34.68
	Average	342	186	267.16	49.61
	Poor	347	107	259.87	62.13
School atmosphere	Good	349	223	287.96	37.68
	Average	345	172	269.45	52.64
	Poor	342	98	257.68	63.19
School quality	Good	349	232	307.64	33.32
	Ordinary	341	174	284.25	49.68
	Poor	339	78	244.97	68.28

students, hence there was a balanced ratio between men and women.

The collected data were sorted into Excel tables and imported into SPSS15.0 software for statistical analysis. The basic information of the data was obtained through descriptive statistics, and the degree of influence of the various factors on students' scores was analyzed using multiple regression analysis.

5. MULTIPLE LINEAR REGRESSION ANALYSIS OF INFLUENCING FACTORS

5.1 Regression Analysis of School Factors

5.1.1 Descriptive Statistics

Table 1 shows the descriptive statistical results of the school factors and students' scores, and Figure 2 shows the influence of school factors on students' average scores. It can be seen that school factors have a significant impact on students' performance. Teaching quality, school atmosphere and school quality all have a positive impact on students' performance. The better the teaching quality, the better the school atmosphere, and the higher the school quality, the better the students' performance.

5.1.2 Regression Analysis and Prediction

As can be seen from Table 3, teaching quality, school atmosphere and school quality have a positive and significant impact on students' performance. The hypothesis proposed in this paper is supported, with R^2 of 0.302, indicating that the model has an explanatory power of 30.2% on student performance. Of these, school quality has the greatest influence on students' performance, teaching quality is second, and school atmosphere has a relatively weak influence on students' performance. Students' performance can be predicted based on the regression results. The higher the school's indicators, the better the students' performance.

5.2 Regression Analysis of Family Factors

5.2.1 Descriptive Statistics

Table 4 and Figure 3 show that family factors are positively correlated with students' academic performance. Students whose parents have a high educational background perform

Table 3 Regression analysis results of school factors.

	Unstandardized coefficient β	The value of T	Significance
Constant	76.264	8.648	0.000
The quality of teaching	4.239	2.384	0.002
School atmosphere	3.648	2.158	0.009
School quality	4.764	3.158	0.001
R^2	0.302		

Table 4 Family factors and student achievement.

Indicators		Maximum value	Minimum value	Average	Standard deviation
Parents' education	High	348	208	312.46	32.16
	Average	339	172	298.47	47.86
	Low	327	148	265.19	62.34
Parents' occupation	Good	347	196	308.96	31.48
	Average	327	107	276.28	52.64
	Poor	289	92	236.18	49.27
Household income	High income	345	178	309.12	33.59
	Medium income	318	112	256.87	42.91
	Low income	297	79	242.13	67.42

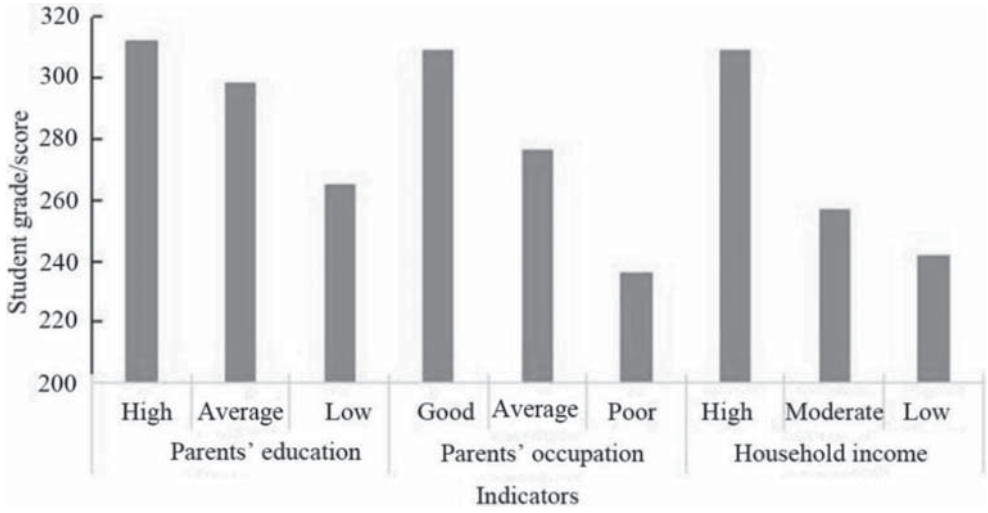

Figure 3 Family factors and students' average scores.

Table 5 Results of family factor regression analysis.

	Unstandardized coefficient β	The value of T	Significance
Constant	82.756	8.426	0.000
Parents' education	4.568	2.976	0.001
Parents' occupation	4.571	2.862	0.001
Household income	3.692	3.002	0.021
R^2	0.189		

significantly better academically than those whose parents have a low educational background. Parents' occupation and family income also have the same impact. Students from low-achieving families have lower and more volatile grades.

5.2.2 Regression Analysis and Prediction

R^2 obtained by regression analysis is 0.189, indicating that the model can explain 18.9% of the changes in students' scores. i.e., family factors have an impact on students' scores, so the hypothesis is supported. Of the three analysis indexes of family factors, parental education and parental occupation have the most significant influence on students' performance, and family income is slightly weaker. All three indicators have a positive impact on students' performance, so it can be predicted that the higher the index value, the higher the student's performance, and the lower the index value, the lower the student's performance.

Table 6 Individual factors and student achievement.

Indicators		Maximum value	Minimum value	Average	Standard deviation
Psychological state	Good	351	212	316.45	31.68
	Average	339	198	272.64	46.48
	Poor	298	67	237.82	62.18
Living habits	Good	348	229	307.59	35.91
	Average	329	176	269.41	51.59
	Poor	286	92	241.32	68.29
The sense of responsibility	High	349	219	308.46	31.51
	Average	321	171	259.87	49.28
	Low	296	75	237.64	61.85

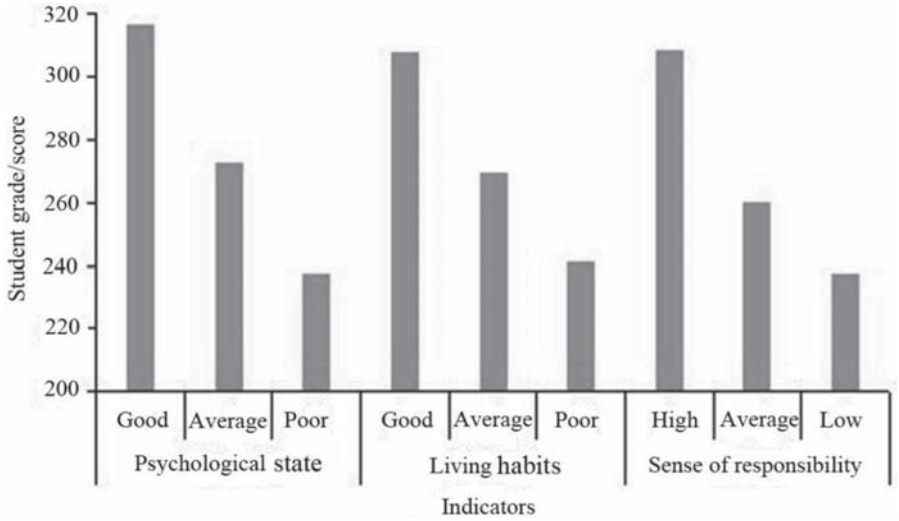

Figure 4 Individual factors and students' average scores.

Table 7 Results of individual factor regression analysis.

	Unstandardized coefficient β	The value of T	Significance
Constant	76.948	8.627	0.000
Psychological state	3.684	3.648	0.021
Living habits	2.145	2.158	0.033
The sense of responsibility	3.593	3.049	0.019
R^2	0.126		

5.3 Regression Analysis of Individual Factors

5.3.1 Descriptive Statistics

Table 6 and Figure 4 show that the hypothesis proposed in this paper, "individual factors will affect student performance" is supported. As shown by the students' average scores, students who are in a better psychological state and have better living habits and a higher sense of responsibility achieve higher scores, while students who are in a poor psychological state and have poor living habits and a lower sense of responsibility achieve lower scores, indicating that individual factors have a positive impact on students' scores.

5.3.2 Regression Analysis and Prediction

As shown in Table 7, R^2 is 0.126 and the model's explanatory power on student performance is 12.6%. Three indicators of individual factors have a positive impact on students' performance, of which a sense of responsibility has the greatest impact. The higher the students' sense of responsibility, the better their grades, followed by psychological state and living habits.

6. DISCUSSION AND CONCLUSION

Student performance is the most intuitive way to measure a student's ability to acquire knowledge and achieve a higher educational level. It plays a very important role in the field of education and research on its influencing factors has a great impact on education workers, parents and the students themselves in terms of improving student performance (Alos et al., 2015). Using multiple linear regression analysis, this paper analyzes the factors which influence students' scores from three perspectives: school, family and individual.

The study found that of the three factors, schools had the greatest impact on student achievement ($R^2 = 0.302$).

The school is the main place where students receive an education and it is the central place where educational teaching activities are carried out. Students spend most of their learning time in school. In this paper, three indicators of school factors were selected for analysis, and the results showed that the influence on students' scores ranked from high to low is as follows: school quality, teaching quality, school atmosphere. The influence of school quality on students' performance is obvious. High school quality refers to the high economic status of schools (Zhang and Campbell, 2015), proficient faculty and good educational conditions (Lafortune et al., 2016), which can contribute to improving student performance. In addition, good schools give preference to high-performing students at the time of admissions, and they perform significantly better than those in average and poor schools after training. Teaching quality is reflected in the proficiency of teachers, the rationality of the school teaching plan and other aspects. High teaching quality indicates that the better the ability of teachers to impart knowledge to students and the stronger the ability of students to absorb knowledge, the higher the score of students. The school atmosphere will influence students' learning enthusiasm imperceptibly. A good school atmosphere can create a positive learning atmosphere and thus have a positive impact on students' performance.

The results of the regression analysis also prove that the hypothesis "family factors affect student performance" is valid. From the perspective of parents' occupation, students whose parents have high scoring occupations such as being in charge of government organisations or enterprises and administrators have higher scores, while students whose parents have low scoring occupations, such as labourers, farmers or are unemployed have lower scores. From the perspective of the educational level of parents, students whose parents have a higher score for education perform better, while students whose parents have a lower score for education perform worse. Family income was also positively correlated with student achievement. When parents have a good career, a high level of education, and a high family income, the family's cultural atmosphere is better. These parents are generally concerned about their children's education (Lam and Ducreux, 2013). They have the ability and financial resources to support their children's education, and choose higher quality schools for their children to ensure a better education (Kilic and Askin, 2013), which positively impacts these students' performance. In the case of poor families, parents tend to be busy with their work and they also tend to neglect their children's education. Being in a lower socio-economic bracket makes it difficult for these families to afford extra education expenditure and they also tend to interact less with their children (Drajea and O'Sullivan, 2014). As a result, these students' performance is relatively poor.

Students are the subject of learning and the individual characteristics of students also have an impact on academic performance. The research results show that students' psychological state, life habits and sense of responsibility have a positive impact on students' grades. When study pressure is great and examination difficulty is high, students who are in a better psychological state can adjust their mental state and have a better attitude towards study and examinations and thereby achieve a better academic performance. Students with a higher sense of responsibility have better requirements for themselves, as well as for study, so they tend to focus more closely on their studies and achieve better academic performance. Living habits can also affect students' grades. Generally speaking, students with good living habits also have good study habits. In addition, good living habits, such as maintaining a healthy work-life balance, eating healthily and exercising regularly help students perform better in their study (Babatunde, 2017) and achieve better academic performance.

The factors which influence student achievement are very complicated. This paper only analyzes the influence of school, family and the individual on students' performance. It does not conduct in-depth research on the interaction between various factors, and the mining of influencing factors is not enough. This requires a more comprehensive and in-depth study to better understand these influencing factors.

To sum up, school, family and individual factors all affect students' performance and different factors have different effects on students' performance. Through regression analysis, this paper provides the reader with a better understanding of the factors affecting students' grades so that predictions can be made about student grades. It provides a theoretical basis for improving students' scores and promoting education development.

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