The Impact of Different Types of Educational Resource Input on Students' Performance—A Case Study of Junior High Schools in Wuhan, China

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ABSTRACT
The relationship between the input of educational resources and the output of student achievement is a critical basis for public education policymaking and a heated issue of debate in educational economics. This article examines the impact of human, physical and financial resource inputs on student grades of 2021 Secondary Examination Results in Wuhan, China. This article also aims to find out the main factors influencing student performance and to provide a series of policy recommendations for government to optimize educational resource allocation. This research uses a linear regression model to identify the relationship between multiple factors and students' achievements. The primary conclusion of this research is that the teacher-student ratio has a significant positive relationship with students' average scores in each school. The improvement of the teacher-student ratio is beneficial to the achievement of students.

Keywords: *Compulsory education, Teacher-student ratio, Public investment in education, Student achievement*

1. INTRODUCTION

The relationship between educational resource inputs and student accomplishment is a contentious issue in education economics and serves as a basis for public education policymaking. The earliest study on this topic may be traced back to the Coleman (1966) report, which showed that resource inputs to public schools had little effect on student achievement [1]. This finding has been extensively contested, resulting in a burst of studies on the relationship between educational resources input and student achievement. Hanushek (1997) contends in a review of studies on educational production functions that there is no strong and consistent link between school resources and student academic achievement [2]. Krueger's (1998) research implies that moderate increases in school investment help promote student performance [3]. Cooper and Cohn's (1997) study confirms the positive effect of a teacher's master's degree on student achievement [4]. Even though existing researches on the relationship between investment in education resources and academic achievement have inconsistent findings, governments continue to expand their expenditure on education. China is no exception and has been increasing its investment in education [5]. The state expenditure on education exceeded RMB 4 trillion in 2019, with an average annual growth rate of 8.2%; it accounts for 4.04% of GDP, remaining at 4% for the eighth consecutive year [6]. Despite the fact that financial investments in compulsory education have been beneficial, in the face of a massive population, educational resources are still insufficient to fulfil demand. As a result, it is critical to maximize output from minimal inputs.

This article examines three types of factors influencing the efficiency of educational inputs and outputs, namely human, physical, and financial resources. This article also aims to find out the main factors influencing student performance and to provide a series of policy recommendations for the government to optimize educational resource allocation. This research uses a linear regression model to identify the relationship between multiple factors and students' achievements. The purpose of this study is to further evaluate whether the allocation of resources under China's compulsory education policy is optimal and to give further suggestions. The study's significance rests in its capacity to increase the efficiency of public education output. The originality of this paper lies in the field investigation of the effectiveness of investment in compulsory education

in the central region of China, which contributes to the empirical research on Chinese education policy.

2. RESEARCH METHOD

This paper uses multiple linear regression to examine the effect of different types of educational resource inputs on students' scores of the High School Entrance Examination. The value of the regression coefficient is used to determine what factors would have a significant positive relationship on students' achievement [7].

2.1 Indicator selection

2.1.1 Selection of input indicators

The indicators for educational resource input chosen for this study comprise indicators from previous studies and municipal policies. The indicators used in previous studies have been subjected to many empirical analyses, indicating that they are relatively dependable. Because the local policy is formed from the actual local situation, the composition of input indicators is better suitable for analyzing actual issues in reality. Educational resources can be categorized into three types: human resources, physical resources, and financial resources. See Table 1.

Table 1. Selection of educational resources input variables.

Type of resources	Initial indicators	Consolidation Indicators
Human resource input	Number of students, number of teachers, number of senior teachers	Teacher-student ratio, ratio of senior teachers to total number of teachers, ratio of senior teachers to students.
Physical resource input	Area of school, area of teaching space	Ratio of teaching space to school area.
Financial resource input	Working personnel expenses, public funds	Per pupil personnel expenditure, per pupil public funds.

2.1.2 Selection of the output indicator

The output indicator selected for this study is the average score of the High School Entrance Examination in each school. Students' grades are a reliable indicator of students' abilities and academic competency in China's compulsory education system [8]. To make exam results from various schools comparable, the output indicator is set as the results of the 2021 High School Entrance Examination from 9 junior high schools in Wuhan, China. Different schools use the same exam paper, therefore the results are comparable across schools.

2.2 Data sources

The local government is the main body in China responsible for the development of compulsory education, and it implements and enforces specific policies. To make the study consistent with the fact that Chinese education input policies are implemented by municipal governments, and to make the study's findings more meaningful to local education policymaking, twelve junior high schools in the city of Wuhan, China, were chosen as the study's targets. Field research in Wuhan was used to obtain data for this paper. The school teachers, from whom the overall situation in the school and in each class was collected, were one of the two kinds of field study subjects. The second category of the subject was the staff of the local Department of Education, from whom more detailed data on resource input in each school was primarily collected.

2.3 Descriptive Analysis

Before the data could be used, it is necessary to sort the data to suit the linear regression model.

First, schools with incomplete data were excluded from the data collection. The next stage was to delete any evidently erroneous data from the school results, leaving a sample of nine schools that met the linear regression model's requirements. Finally, the processed data were entered into the SPSS software, which generated descriptive statistics. The results are shown in Table 2.

Table 2. Descriptive statistics for collected data.

Items	N of samples	Min	Max	Mean	Std. Deviation	Median
Teacher-student ratio	9	0.004	0.08	0.051	0.027	0.059
Ratio of senior teachers to total number of teachers	9	0.086	0.5	0.251	0.145	0.2
Ratio of senior teachers to students	9	0.01	0.402	0.13	0.163	0.025
Ratio of teaching space to school area	9	0.45	0.971	0.763	0.172	0.832
Per pupil personnel expenditure	9	17260	43740	25890	7860	24560
Per pupil public funds	9	0.133	0.519	0.252	0.13	0.193

3. RESULTS AND ANALYSIS

Table 3. Results of regression analysis of the impact of school resource inputs on student achievement.

Parameter Estimates (n=9)									
	Unstandardized Coefficients		Standardized Coefficients	t	p	VIF	R^2	Adj R^2	F□
	B	Std. Error	Beta						
Constant	345.009	11.727	-	29.420	0.001**	-			
Teacher-student ratio	440.300	56.127	1.008	7.845	0.016*	2.379			
Ratio of senior teachers to total number of teachers	10.156	17.801	0.124	0.571	0.626	6.788			
Ratio of senior teachers to students	-0.815	16.545	-0.011	-0.049	0.965	7.447	0.986	0.944	*F (6,2)=23.663,p=0.041*
Ratio of teaching space to school area	12.045	6.831	0.174	1.763	0.220	1.403			
Per pupil personnel expenditure	3.885	4.088	0.257	0.951	0.442	10.503			
Per pupil public funds	-2.889	18.646	-0.032	-0.155	0.891	5.977			

Dependent Variable: Scores

D-W: 2.445

* p<0.05 ** p<0.01

From the above table 3, it can be seen that teacher-student ratio, the ratio of senior teachers to the total number of teachers, the ratio of senior teachers to students, the ratio of teaching space to school area, per-pupil personnel expenditure, and per-pupil public funds are set as independent variables and students' average scores as the dependent variable for linear regression analysis. From the above table, the model equation is: Scores = 345.009 + 440.300*Teacher-student ratio + 10.156*Ratio of senior teachers to the total number of teachers - 0.815*Ratio of senior teachers to students + 12.045*Ratio of teaching space to school area + 3.885*Per pupil personnel expenditure-2.889*Per pupil public funds, with a model R-squared value of 0.986. This result implies that these independent variables can explain 98.6% of the variation in scores.

The final specific analysis shows as follows: the value of the regression coefficient for the teacher-student ratio is 440.300 ($t=7.845$, $p=0.016<0.05$), implying that the teacher-student ratio has a significant positive relationship with students' average score in each school. The value of the regression coefficient of the ratio of senior teachers to a total number of teachers is 10.156 ($t=0.571$, $p=0.626>0.05$), implying that the ratio of senior teachers to the total number of teachers does not have an influential relationship on Scores. The ratio of senior teachers to students is -0.815 ($t=-0.049$, $p=0.965>0.05$), which means that the ratio of senior teachers to students does not have an effect on Scores. The regression coefficient of the ratio of teaching space to school area is 12.045 ($t=1.763$, $p=0.220>0.05$), implying that the ratio of teaching space to school area does not have an effect on Scores. The regression coefficient of per-pupil personnel expenditure is 3.885 ($t=0.951$, $p=0.442>0.05$), implying that per-pupil personnel expenditure does not have an effect on Scores. The regression coefficient value for Per pupil public funds is -2.889 ($t=-0.155$, $p=0.891>0.05$), implying that per-pupil public funds do not have an impact on Scores.

To conclude the analysis, it is clear that the teacher-student ratio has a significant positive effect on scores. However, the ratio of senior teachers to the total number of teachers, the ratio of senior teachers to students, the ratio of teaching space to school area, per-pupil personnel expenditure, and per-pupil public funds do not have a positive effect on scores.

4. DISCUSSION

Increasing the number of teachers is certainly a crucial step toward improving educational quality as China continues to accelerate the growth of compulsory education. The positive impact of the teacher-student ratio on student achievement is significant among the human resource input indicators, showing that the teacher-student ratio is an important factor that affects student accomplishment. The same conclusion as Schwartz et al. found, when the number of students remains the same, increasing the number of teachers can effectively improve student performance, especially for low achievers, minority students and students from lower socioeconomic backgrounds [9][10][11][12][13]. Based on the findings of the above study, Chinese local governments may consider increasing the number of teachers when allocating more resources to schools in the future, especially emphasizing that the under-resourced groups should also have access to the same high quality of education to develop their abilities since the equity in education is a fundamental national policy of China [14].

5. CONCLUSION

The study uses field research and regression analysis to determine the many ways in which public education inputs influence students' achievement, offering a comprehensive picture of the complimentary impacts of public education inputs. The goal of the linear regression analysis is to identify the contributing input factors and give suggestions on how to effectively invest in public education. The primary conclusion of this research is that the teacher-student ratio has a significant positive impact on students' average scores in each school. The improvement of the teacher-student ratio is beneficial to the achievement of students. In order to improve student performance, local governments should invest more human resources in education by improving the teacher-student ratio.

However, this paper does not consider the impact of family educational resource inputs on academic performance. This may be a limitation of this study. Many studies have indicated that parental wealth is an important factor in determining children's school achievement [15]. One notable example is the number of reading materials available in the home to encourage children to spend time reading, which has been found to be positively associated with children's academic achievement [16]. In addition, the sample size in this research is limited, and bigger sample sizes would be necessary for future validation studies. Before examining the influence of educational resource inputs on student achievement, the impact of family resources on student achievement must also be considered and controlled.

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