

The spatial impact of different factors on the Grades of Undergraduates' Bachelor Degree Thesis

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Abstract: Bachelor Degree Thesis is a very important part of undergraduate academic performance in geographical colleges and universities. In addition, Bachelor Degree Thesis is a good prove of whether students have comprehensively understood the fundamental theories and mastered the professional skills to solve practical problems. Therefore, based on statistical correlation analysis and spatial analysis, this paper is purposed to examine how different factors spatially impact the grades of undergraduates' Bachelor Degree Thesis as well as their temporal variations from Year 2004 to 2015 with China University of Geosciences as a case study. The results show that: (1) Fundamental courses in mathematics and physics had the highest positive correlation with the results of Bachelor Degree Thesis grades; (2) The correlations between course grades and Bachelor Degree Thesis grades showed significant spatial differences; (3) Compared to the regional economic development, the quality of regional education has a greater impact on the college entrance examination grades of students who choose geology related majors.

1. Introduction

Bachelor Degree Thesis are an important way to test students' ability to comprehensively use their knowledge and skills to solve practical problems and to perform preliminary scientific research^[1]. The performance evaluations of Bachelor Degree Thesis are mainly based on the quality of the graduation project and of the accompanying presentation. Students must complete all courses specified in the syllabus and pass the corresponding examinations before they can participate in a graduation project. Bachelor Degree Thesis are the final practicum in colleges and universities^[2]. Bachelor Degree Thesis usually include the process of topic selection, translation from a foreign language, literature review, writing an opening report, design, writing a thesis, and giving a presentation. The purpose of the graduation project is to cultivate students' comprehensive ability to consult the literature, translate materials, integrate theory with practice, solve problems, and write papers^[3]. The quality of the graduation project is affected by many factors, such as the mastery of the material in prerequisite courses, the source of the students, the foundation of learning before entering college, etc.

2. Data

This paper selects students in the graduating classes of 2004-2015 in the School of Geosciences and Resources of China University of Geosciences as the research subject. These students were undergraduates majoring in geology, resource exploration engineering, and geochemistry. The research data include the final grades for fundamental courses, the grades for the undergraduate Bachelor Degree Thesis, college entrance examination grades, the GDP data of students' places of origin, the student/teacher ratio, etc. Among them, the final grades for fundamental courses include grades for physical education, foreign languages, mathematics, physics, computer science, and political science. The GDP and student-teacher ratio data of each province from 2004 to 2015 used in this paper are public data obtained from the China Economic Network.

3. Data preprocessing

(1) Data classification: Ten courses (College Physical Education I-IV, College English I-II, Advanced Mathematics I-II, College Physics I-II, College Computer, Computer Language Programming, Ethics and Fundamentals of Law, Principles of Marxism) were divided into six categories: sports, foreign languages, mathematics, physics, computer science, and political science.

(2) Data conversion: Grades were converted into hundreds as follows: Excellent = 90 points, Good = 80 points, Medium = 70 points, Pass = 60 points, Failing or missing grade = 0 points. In the processing of college entrance examination results, we normalized the college entrance examination grades of the various provinces to 100 points. This process makes the standards of data consistent and improves the authenticity of the data.

4. Data analysis method

(1) Data correlation analysis. In this paper, the Pearson product moment correlation coefficient was calculated in SPSS to represent the correlation of data. The correlation coefficient can take any value between - 1 and 1. If the correlation coefficient is positive, it means that there is a positive correlation between the two variables; otherwise, it is a negative correlation. The higher the absolute value of the correlation coefficient, the higher the degree of linear correlation between the two variables. If the significance level is less than 0.05, the correlation between the two variables is significant.

(2) Spatial distribution of data. The correlation coefficients between the grades on fundamental courses and Bachelor Degree Thesis were calculated by SPSS. Then the correlation coefficient was imported into the vector file through ArcGIS to analyze the spatial distribution of undergraduate fundamental course grades and graduation Bachelor Degree Thesis grades in various provinces. The thematic map distribution is represented according to its correlation attributes.

(3) Multiple Linear Regression. The graduation project grade is the dependent variable, and the grades on the various fundamental courses are the independent variables. We analyzed the impact of fundamental course grades on graduation Bachelor Degree Thesis grades by SPSS. If the significance level of the output results is less than 0.05, the regression equation is considered to be effective.

(4) Geographically weighted model (GWM). The spatial weight function used by GWR is usually a Gaussian function and Bi square function; these estimated the coefficients of the geographically weighted regression model accurately. The partial regression coefficient was estimated according to the spatial weight of the research object. Normalized residual rendering maps were generated in ArcMap to evaluate the reliability of coefficient estimates in the results.

5. Data results

5.1 Influence of fundamental undergraduate course grades on graduation Bachelor Degree Thesis grades

5.1.1 Correlation between graduation Bachelor Degree Thesis grades and fundamental course grades

First, we calculated the correlation coefficient between the graduation project grade and the grades of various fundamental courses. Then we analyzed the grades that had a significant correlation with the graduation project grade. The correlation coefficients between the graduation project grade and the grades of various fundamental courses are shown in Table 1. The output results show that when the number of all data cases was enough, the correlation significance level was 0.01. The correlation is therefore significant. Among the correlation coefficients between all grades, the correlation between graduation Bachelor Degree Thesis grades and mathematics grades is the largest, followed by physics grades. Foreign language and sports grades are the least relevant.

Table 1: Correlation between graduation Bachelor Degree Thesis grades and fundamental course grades

	Sports	Foreign Languages	Mathematics	Physics	Computer Science	Political Science
Correlation	0.189	0.104	0.327	0.288	0.205	0.272
Significance	0.000	0.000	0.000	0.000	0.000	0.000
Number of Samples	3135	3135	3135	3135	3135	3135

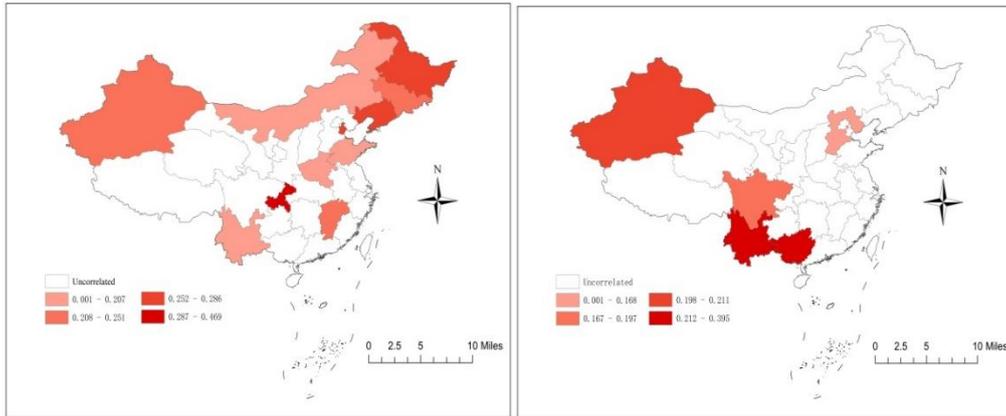
5.1.2 Spatial distribution characteristics of grade correlations

We imported the correlation coefficients between the graduation Bachelor Degree Thesis grades and the grades of various fundamental courses into the vector file through ArcGIS and obtained the spatial distribution map of the correlation between the grades in each province (Fig.1). The blank areas in the figure show that the correlation was not significant or there was no data in those areas. The relevance of the rest of the provinces and cities is indicated by color depth. As can be seen from the figures, the correlations between the grades in mathematics and physics in most provinces and the grades on Bachelor Degree Thesis are significant. Among the grades of all fundamental courses, mathematics grades are significantly correlated over a wide spatial extent, followed by physics grades.

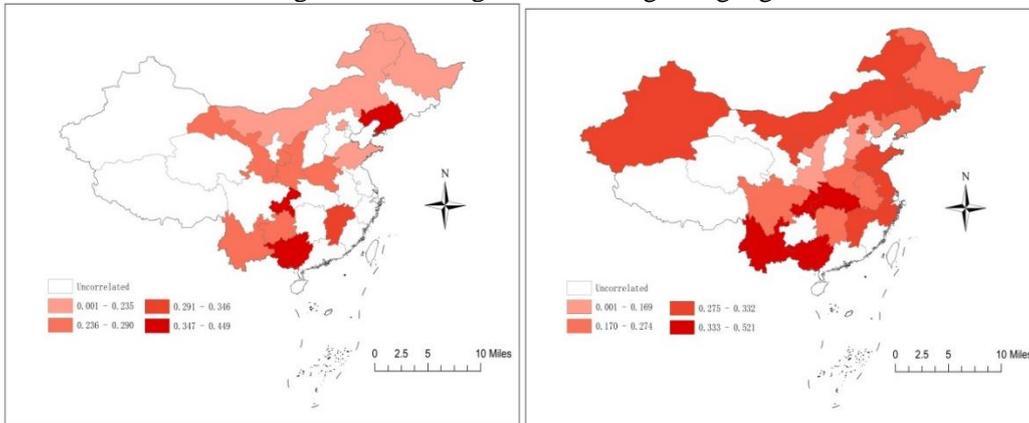
5.1.3 Degree of influence

All data were analyzed by multiple linear regression. R is the correlation coefficient between variables, and R^2 represents the influence degree of independent variables on dependent variables. The output results show that the significance level of each variable coefficient and the significance level of the model are less than 0.05.

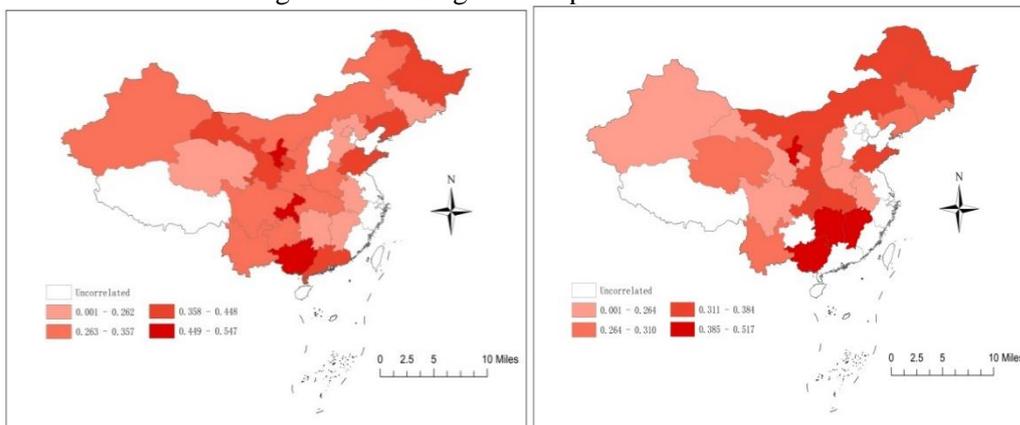
This shows that the regression equation established according to the variable coefficients is effective, and the grades on fundamental courses have a positive correlation with the grades on Bachelor Degree Thesis. Among them, the maximum standardization coefficient is that for mathematics, 0.914. This shows that mathematics grades have the greatest impact on graduation Bachelor Degree Thesis grades, followed by physics grades and political science grades.



- a. Spatial distribution map of the correlation between the grades of graduation project and the grades of sports
- b. Spatial distribution map of the correlation between the grades of graduation Bachelor Degree Thesis grades and the grades of foreign languages



- c. Spatial distribution map of the correlation between the grades of graduation Bachelor Degree Thesis grades and the grades of computer science
- d. Spatial distribution map of the correlation between the grades of graduation Bachelor Degree Thesis grades and the grades of political science



- e. Spatial distribution map of the correlation between the grades of graduation Bachelor Degree Thesis grades and the grades of mathematics
- f. Spatial distribution map of the correlation between the grades of graduation Bachelor Degree Thesis grades and the grades of physics

Figure 1. Correlation distribution maps between grades on fundamental courses and Bachelor Degree Thesis.

5.2 Correlation analysis between Bachelor Degree Thesis and college entrance examination results

In addition to the research on the spatial scale, this paper analyzes correlations over time, finding a correlation between college entrance examination results and grades on undergraduate Bachelor Degree Thesis. Cases were selected according to year, and the correlation between college entrance examination grades and graduation Bachelor Degree Thesis grades were analyzed in the five years from 2010 to 2014 (Table 3). The results show that the correlation coefficients of the two grades are less than 0.05, and thus the results are significant. There is a positive correlation between graduation project grade and college entrance examination grade, and the correlation changes with time. It can be seen that the correlation coefficient between the two first increases and then decreases.

Table 2: Relevant parameters of the global data regression equation

Variable	Standardization coefficient	Significance	R ²	Model significance
Mathematics	0.194	0.000	0.147	0.000
Physics	0.149	0.000		
Political science	0.091	0.000		
Sports	0.064	0.000		
Foreign languages	0.049	0.004		

Table 3: Correlation between college entrance examination grades and graduation Bachelor Degree Thesis grades

Years	Correlation	Significance	Number Of Samples
2010	0.143	0.020	258
2011	0.149	0.015	269
2012	0.150	0.100	253
2013	0.144	0.015	263
2014	0.135	0.045	221

5.3 Correlation analysis between graduation project and regional economic level and education level

There is a significant correlation between the college entrance examination grades and undergraduate graduation Bachelor Degree Thesis grades. This paper further traces the two important factors affecting college entrance examination grades in different regions, including regional GDP and student-teacher ratio, which reflect the regional economic and education levels.

5.3.1 Correlation analysis between regional GDP data and undergraduate graduation Bachelor Degree Thesis grades

The coefficients of each independent variable in different provinces of the country were obtained through GWR, and the coefficient distribution rendering was obtained by displaying the coefficients of the two independent variables. The GDP coefficients of all provinces in China tend to be 0, indicating that there is little correlation between GDP and graduation Bachelor Degree Thesis grades. The economic level of each province thus has little relationship with students' academic performance at the undergraduate stage.

5.3.2 Correlation analysis between the student-teacher ratio of regional basic education and undergraduate graduation Bachelor Degree Thesis grades

The rendering map of the coefficients of the student-teacher ratios of each province was obtained through GWR. The results show that there is a positive correlation between student-teacher ratios and students' graduation Bachelor Degree Thesis grades. In the regional distribution, the influence degree gradually decreases from north to south, and the highest value appears in the northeast and northwest. It can be seen that the quality of education at the stage of basic education has an impact on students' long-term learning.

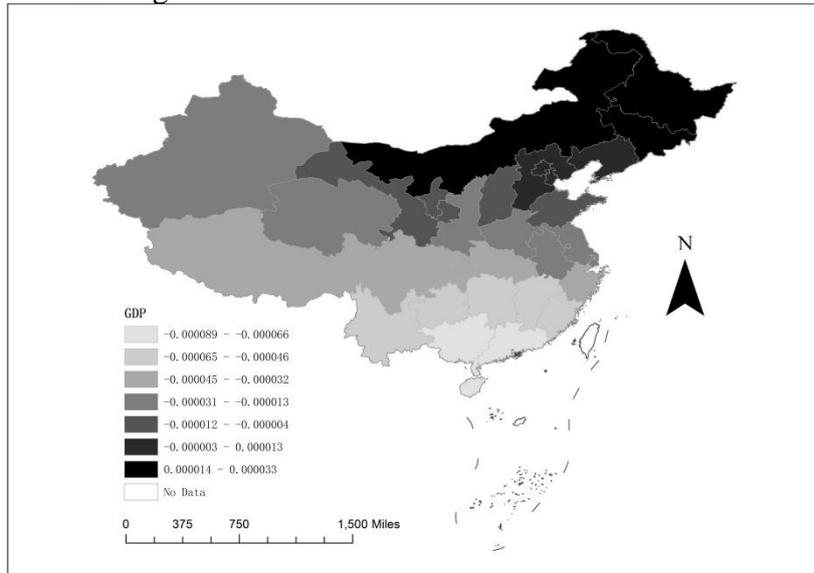


Figure 2. Variable coefficients map of geographically weighted regression results for GDP

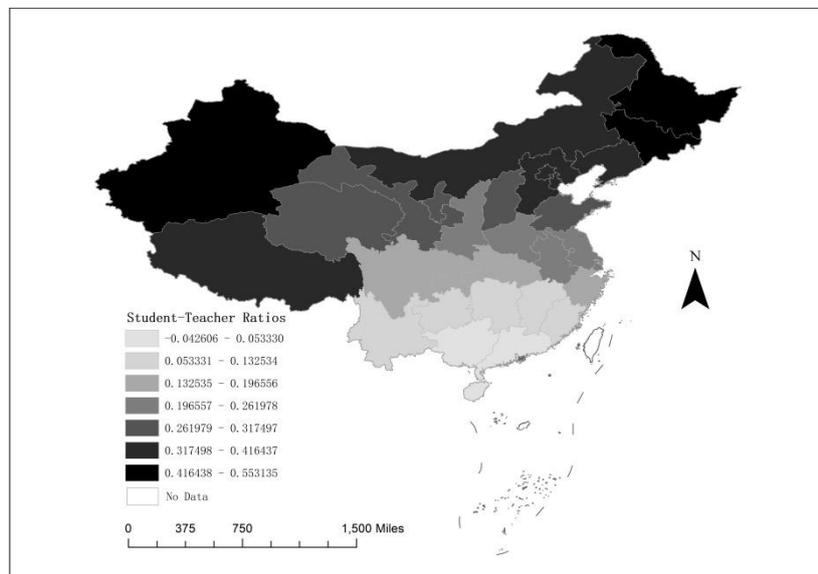


Figure 3. Variable coefficients map of geographically weighted regression results for student-teacher ratios

6. Discussion

6.1 There is a close relationship between undergraduate graduation Bachelor Degree Thesis grades and grades in fundamental courses at the undergraduate stage

The curriculum is the basis of talent training. There is a positive correlation between the grades in fundamental undergraduate courses and graduation Bachelor Degree Thesis grades, and the correlation with mathematics and physics is the largest. Geology is a natural science with multi-disciplinary mutual penetration and close combination with basic disciplines such as mathematics, physics, and chemistry [4]. Because geology has the complexity of mutual restriction of many factors, any geological process will not simply be a single physical or chemical process. Therefore, in the process of training undergraduates majoring in geology, we must strengthen foundational education, especially in mathematics, and focus heavily on interdisciplinary approaches [5]. We must lay a solid foundation for students in relevant interdisciplinary learning and research. With this foundation, students in all majors of geology will be able to succeed in their further careers [6-8].

6.2 The correlation of grades shows regional differentiation characteristics

There are clear-cut regional differences in the correlation between fundamental course grades and undergraduate graduation Bachelor Degree Thesis grades; in other words, students' fundamental course grades have different degrees of influence on their graduation Bachelor Degree Thesis grades in different regions. The correlation between the results for fundamental courses in mathematics and physics and graduation Bachelor Degree Thesis grades has the widest influence range. In the central region of China, mathematics and physics have the greatest impact. On the one hand, this may be because geology-related majors can be divided into engineering and science majors. There are differences in the requirements for mathematics achievement between the two disciplines. On the other hand, research on students' mathematical ability has always been a hot issue in the field of education, and there are also differences in mathematical ability between the genders [9]. However, such gender differences are not the main influencing factor discussed in this paper. Under the influence of comprehensive factors, the regional differentiation of performance is still worthy of in-depth discussion.

6.3 Among the main influencing factors of regional differences in academic achievement, regional education is more influential than GDP

"Student-teacher ratio" is an important data point in education. To some extent, it reflects the utilization efficiency of human resources and the size of education scale in colleges and universities. It also reflects the efficiency and quality of education in the region or school. Students' education in fundamental courses is a step-by-step process. The educational investment that occurs before students enter college will indirectly affect their learning over the course of their college careers. Of course, with the passage of time, the impact of early learning on students' later development will gradually decrease. While strengthening regional economic development, all regions should also increase investment in education to lay a solid foundation for students to enter higher education. This is of great significance to improve students' comprehensive ability to solve professional problems.

7. Conclusion

Taking the graduation Bachelor Degree Thesis grades of students in geology-related majors as the research object, this paper discussed the factors affecting graduation Bachelor Degree Thesis grades from the perspective of grades in fundamental courses. The fundamental undergraduate courses most closely related to graduation Bachelor Degree Thesis grades are in mathematics. The results of spatial analysis of grade correlations show that the correlation between grades in mathematics and physics and grades for Bachelor Degree Thesis is common in most provinces. Moreover, the influence degree has regional differentiation characteristics. The education received before the undergraduate stage by students majoring in geology has a certain impact on their success in the undergraduate stage. Among the influencing factors, this paper compares the education level and economic development level of each region. It is found that the impact of regional education level is the higher of the two.

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References

- [1] Cao Liwen, Piao Chunde. *Teaching Practice and Thinking on Graduation Thesis of Geological Engineering* [J]. *Chinese Geological Education*. 2009(4):118-121.
- [2] Guo Huishi, Li Wenfeng, Gui Yanghai et al. *Factors affecting the quality of undergraduate graduation project and its new reform idea*[J]. *Henan Chemical Industry*. 2019(36):53-55.
- [3] Wang Chunsheng. *Research on the reform of undergraduate graduation design* [J]. *Heilongjiang Education (Higher Education Research & Appraisal)*.2020(10):86-87.
- [4] Bi Kongzhang, Hu Xuankui. *Thoughts and suggestions on Geoscience Education*. *Chinese Geological Education* [J], 2002 (20): 58-60.
- [5] Qu Xiyu, Qiu Longwei. *Discussion on Undergraduates Training Model of Geology in the College—Revelation from Comparing Undergraduates Training Schemes of Geology*. *Education teaching forum* [J], 2018(27), 80-83.
- [6] Lu Yongxiang. *The significance of interdisciplinary and interdisciplinary science*. *Bulletin of Chinese Academy of Sciences* [J], 2005 (20): 58-60.
- [7] Yu Jicong, Liu Yuexiagn, Zhao Weizhen. *Reflections on the development of geological education in the new era*. *Chinese Geological Education* [J], 2018(2):1-5.
- [8] *Exploration and practice of innovative talent training mode in Geosciences and Sciences*. *Chinese Geological Education* [J], 2004 (4): 29-33.
- [9] Guan Dandan. *Gender difference on math assessment in high school students in China* [J]. *Journal of Mathematics Education*. 2017, 26(6):22-26.
- [10] Chen Ze, Hu Bicheng. *The Student-teacher Ratio: Important Indicator of Quality of Personnel Cultivation* [J]. *University education science*. 2013(3):118-124.
- [11] Fan Hua. *The relationship between the student-teacher ratio and the quality of university in the process of higher education population: the enlightenment from the world's first-class university* [J]. *Research in Educational Development*. 2012(23):8-15.