The European Proceedings of
Social & Behavioural Sciences
EpSBS

Future Academy ISSN: 2357-1330

http://dx.doi.org/10.15405/epsbs.2017.10.21

8th ICEEPSY 2017
The International Conference on Education and Educational Psychology

THE EFFECT OF PRIMARY SCHOOL SIZE ON LEARNING MANDARIN AS A SECOND LANGUAGE: AN EMPIRICAL RESEARCH ON ETHNIC MINORITY STUDENTS IN CHINA

Ying Zhang (a), Yufang Bian (b)*, Hengli Peng (c)
*Corresponding author

(a) Beijing Normal University, Hai Dian District, Beijing, China, zzhangyingg@163.com,18618100221
(b) Beijing Normal University, Hai Dian District, Beijing, China, ffangyuann@163.com, 18618100221
(c) Beijing Normal University, Hai Dian District, Beijing, China, zzhangyingg@tom.com, 18618100221

Abstract

The purpose of this study was to explore the effects of school size in relation to the added-value of the Mandarin performance test. Data were collected from 5th & 6th Grades Mandarin academic tests, and a questionnaire. 3642 students and 158 principals were identified through stratified sampling from 158 primary schools in the Xinjiang Autonomous Region in China. The Hierarchical Linear Model (HLM) was used to analyse the data. Findings demonstrated that: 1) There is a positive linear relationship between school size and the Mandarin added-value scores, therefore the value-added scores are greater. 2) Under the condition of no-controlling background variable on the stated school sizes, students in the schools of more than 810 students got significantly higher added-value scores than their counterparts in the schools of less than 810 students. However, under the additional condition of controlling background variables, there is no such relationship between them. This study may help the educators and government improve Mandarin education in minority areas in China.

Keywords: School Size, Added-value scores, Mandarin performance test.

http://dx.doi.org/10.15405/epsbs.2017.10.21
Corresponding Author: Yufang Bian
Selection and peer-review under responsibility of the Organizing Committee of the conference
eISSN: 2357-1330

1. Introduction

The influence of school size (school scale) has been central to the field of education research for half a century. In international studies, the school size is widely associated with the number of students and the school number. Considering the comparability between them, the school size concept will be used in demonstrating the empirical results here.

1.1. Background

China is a multi-ethnic country, where different ethnic groups have their own languages. In these autonomous regions, Mandarin is the second language which they learn in school. Mandarin can make ethnic minority students in China become more competitive and have more chances of employment. They start to learn how to speak, read, and write in Mandarin since their primary education. For most of these students, however, school is the only place where they can practice or communicate with each other in Mandarin. School is the most important factor here, a place for them to learn Mandarin. In addition, the influence of school size on students' Mandarin learning also cannot be ignored.

1.2. Literature Review——Effects of School Size on students' academic performance

The effects of School Size can be traced back to 1960s which have determined the results of the empirical researches on school factors including the school size influence on the students' academic achievement. The American scholar Kiesling et al. (1968) stated that there was a significant negative correlation between the primary students' school performance and high school size in New York school districts. After 20 years, especially in the primary stage, most empirical studies showed that smaller schools had more independent and positive effects on the student's academic performance than the larger ones. Since 1990, based on a large sample of empirical research, 57 studies were made on school size. The research data used were generated by The Trends in International Mathematics and Science Study (TIMSS) and the National Education Longitudinal Study of 1988 (NELS: 88). 9 out of these studies were related to primary school, however, no significant correlation between school size and students' academic performance was found (Saddoski & Willson, 2016). In 1990, the studies conducted by Ebert et al. demonstrated that there was a significant negative correlation between them, which means that, the smaller the school is, the better the student's academic achievement is. In the previous literature of school size and academic performance, there were 19 studies related to high school. Bradley and Taylor et al. developed five studies (1998), and they identified that as the school size grew, students' academic performance and the annual increment soared. Evidence from Swakins et al's six studies indicated that an inverted U-shape relationship existed between the school size and the academic performance and the optimal school size was 1200 students. Before the inflection point of 1200 students, student's academic performance increased while after that point, a decline followed.

Andrews et al. (2002) found from their eight studies that along with the growth of the school size, there was a trend of decline in the students' academic performance. In 2009, Kenneth published a paper based on the relationship between school size and students' social and economic background. Kenneth concluded that for primary schools, when most of the students were from disadvantaged or complex social and economic groups, the optimal number of students should be limited below 300; when the

http://dx.doi.org/10.15405/epsbs.2017.10.21
Corresponding Author: Yufang Bian
Selection and peer-review under responsibility of the Organizing Committee of the conference
eISSN: 2357-1330

students they serve are largely from the advantaged social and economic groups or of diverse backgrounds, the school size should be below 500 students. For high schools, most of the students were from disadvantaged or complex social and economic groups, the optimal number of students should be limited below 600; when the students they serve are from a diverse social and economic background or a single student groups, the school size should be below 1000 students.

Apparently, the abovementioned empirical research led to different results regarding the influence of school size on students' performance. The American scholar Jacob (2009) pointed out that the three factors attributed to the difference. First of all, there was a lack of unified definition of the core concepts in previous literature. For instance, the criteria of delimiting the school size, the critical path to distinguish large-size from small-size school, was not fully defined. Another example is the measurement of student's academic achievement. It was measured by the standardized test scores and graduation rates. The measurement should be replaced by the current annual academic performance? Which one is more valuable? Second, in terms of data analysis method and its design, most researchers did not consider the characteristics of nested data, and they mainly use the traditional correlation analysis, regression, analysis and other methods. Finally, there are background variables that may affect the education fair. While studies did not usually control the background variables, some studies control socioeconomic variables; in the meantime, some studies also controlled other variables such as school regional, students' gender variables.

2. Problem Statement

Although there was a large quantity of literature about the influence of school size on student's academic performance internationally, there are no research on the relationship between school size and Chinese ethnic minority students' performance in Mandarin learning. In order to address this gap, there should be more empirical research of a larger sample on the relationship between school size and ethnic minority students' academic performance in Mandarin learning.

3. Research Questions

This research uses stratified sampling (classes) in proportion of 10%. Because several counties in Xinjiang Province almost have no minority students although there are 98 counties in total. According to the proportion of 10% extraction below 1 class, the number of extracting counties is 91. Moreover, 158 primary schools in Xinjiang including 3642 6th Grade student took part in this research. Among them, there are 1658 male students and 1984 female students, which account for 45.5% and 54.5% of sampling students respectively. All the information comes from the statistical data of "Xinjiang Assessment toward Bilingual Education Quality " (2012-2013).

The data collection tools include 5th Grade Mandarin academic test, 6th Grade Mandarin academic test, 6th Grade student questionnaire, and school principal questionnaire.

3.1. Mandarin academic tests

The Mandarin academic tests used in the research are set by language experts in line with the "Chinese Curriculum Standards for Compulsory Education" (*yiwu jiaoyu yuwen kecheng biaozhun*) which

http://dx.doi.org/10.15405/epsbs.2017.10.21
Corresponding Author: Yufang Bian
Selection and peer-review under responsibility of the Organizing Committee of the conference
eISSN: 2357-1330

is under completely undisclosed conditions. In strict accordance with the procedure of measurement, based on the line of cutoff scores, the students are divided into two types of passing grades/falling levels.

Table 01. Reliability and Validity of the Mandarin Academic Tests

Grade	**Reliability**		**Validity**	
	internal consistency	split-half reliability	content validity	item-total correlation
Grade Five	0.77	0.74	≥0.45	0.16~0.54
Grade Six	0.83	0.79	≥0.45	0.14~0.58

3.2. Student Questionnaire and School Principal Questionnaire

The student questionnaire is set based on the study of the literatures regarding the assessment of educational quality. Prior to this research, we conducted in-depth interviews for Mandarin teachers and sixth grade students. Psychological and Educational experts were invited to participate in the preparation of the questionnaire process. The student questionnaire includes demographic information, such as students' family background information and the school principal questionnaire includes the bilingual teaching type of school, school district, school size, etc.

4. Purpose of the Study

This study is based on the provincial compulsory education of tracing data characteristics of academic quality monitoring, using the method of empirical study, along with suitable methods with nested data structure of the multi-layers linear model method. This is controlled under the students' condition and the school background variables to explore the relationship between the school size and students' academic performance (percent of pass, value-added scores). The findings here may help the educators and government improve the mandarin education in minority areas in China. Furthermore, this study will explore other variables which may affect students' mandarin learning, such as students' level of background variables including gender, ethnic category, and family socioeconomic status, and the level of school background variables including the schools' socioeconomic status, school areas, and school type.

5. Research Methods

Samples of 3642 students from 2011 to 2013 participated in the *"Xinjiang Assessment toward Bilingual Education Quality"* (grade four, grade five, and grade six), by completing the student questionnaire. Moreover, 158 primary school principals completed the principal questionnaire.

5.1. Variable Selection

In the research, we use the *School Size* as the determinable independent variable. Student-level (level-1): the student's background variables (including gender, ethnic group, student's family socioeconomic status) and school-level (level-2): the school's background variables (including school location, school's socioeconomic status) as the control variables. We use Mandarin academic scores

http://dx.doi.org/10.15405/epsbs.2017.10.21
Corresponding Author: Yufang Bian
Selection and peer-review under responsibility of the Organizing Committee of the conference
eISSN: 2357-1330

(including pass rate and added value) as the dependent variable in the research. Account for relevant variables goes as follows:

- **School Size, (SCHSIZE)**: Independent Variable, classified variable. Based on the documents specified on "Primary School Management" which was made by the former State Education Commission of China (1996), the number of classes should not –exceed 45 students. Accordingly, we first determined that there is only one class in each grade, and six grades in each school. Therefore, we take this as a starting point for calculating that 45students × 6grades = 270 students, and then escalating step by step and formulating our school size.

Table 02. School Size Classification

School Size Classification	Number of Enrolled Students	Number of School	Percentage
1	(0,270)	26	16.3%
2	(270,540)	53	33.7%
3	(540,810)	45	28.4%
4	(810,1080)	19	12.1%
5	(1080,1350)	10	6.3%
6	>1350	5	3.1%

- **Added-Value:** Dependent Variable, continuous variable, the increasing scores of Mandarin competency test or the academic performance indicators in this research. This refers to the students from fifth grade to sixth grade value-added scores of the Mandarin competency test, which reflects the improvement of students' Mandarin competency in a year.
- **Gender:** Control Variables, classified variable.
- **Ethnic Groups (ETHGRO)**: Control Variables, classified variable. According to the Ethnic Group which the students belonged to, we divided the students into eight groups, including Kazak, Han, Hui, Khalkhas, Mongolian, Tajik, Uighur, Uzbek, and we encoded them from 1 to 8.
- **Social Economic Status(SES):** Control Variables, continuous variable. Based on the International Standard Classification of Education (ISCED) (OECD, 2009), our SES index is derived from three variables related to family background: highest level of parental education (in number of years of education according to the ISCED classification), highest parental occupation (HISEI score) and the number of home possessions (WLEs). Specifically, we used these three variables because the socio-economic status is usually based on education, occupational status, and income. As no direct income measure is available from the data collected, the existence of household items is used as an approximate measure of family wealth.
- **School Social Economic Status(SCHSES):** Control Variables, continuous variable. We use the mean of students' family socio-economic status scores to calculate our social and economic status index.

http://dx.doi.org/10.15405/epsbs.2017.10.21
Corresponding Author: Yufang Bian
Selection and peer-review under responsibility of the Organizing Committee of the conference
eISSN: 2357-1330

- **School District(SCHDIS):** Control Variables, classified variable. According to the school district, we divided all schools in the research into four districts
- **School Type(SCHTYPE):** Control Variables, classified variable, based on the forms of teaching organization. All the schools are public in our research, and we divided these schools into two types: 1. Mandarin is just said in their Mandarin class, or students used it just for the Mandarin competency test, which means that they almost don't use Mandarin in other courses; 2. All courses at school are mainly taught in Mandarin.

5.2. Data Analysis Method

The missing values for students with one missing response and two valid responses were imputed with predicted values plus a random component based on a regression of the variable with missing responses on the other two variables. Variables with imputed values were then transformed into an international metric using the OECD averages of 0 and the OECD standard deviations of 1. These OECD standard variables were used for a principal component analysis by applying an OECD population weight giving each OECD country a weight of 1000.

We use the method for a multi-layer Linear Model to process the data. Comparing it to the traditional regression method, it has a relatively weak statistical hypothesis, and it can make full use of the given information of different levels. It has the advantage of estimating more accurately and interpreting more reasonably. The multi-layer linear analysis software package HLM6.08 is the common tool to deal with nested data. In this research, we mainly use two main layers of linear model: the first layer level for the students, the second level for the school.

In the process of analysis, it mainly includes three models:

Model 1-a: Null Model (Baseline Model for preparing):

Level-1: (Student Level) $\mathrm{Y_{ij}} = \beta_{0j} + \gamma_{ij}$

Level-2: (School Level) $\beta_{0j} = \gamma_{00} + \mu_{0j}$

Model 2-a: Adding SCHSIZE into the Model:

Level-1: (Student Level) $\mathrm{Y_{ij}} = \beta_{0j} + \gamma_{ij}$

Level-2: (School Level) $\beta_{0j} = \gamma_{00} + \gamma_{0j}\mathrm{SCHSIZE} + \mu_{0j}$

Model 2-b: Adding SCHSIZE and $\mathrm{SCHSIZE}^2$ into the Model:

Level-1: (Student Level) $\mathrm{Y_{ij}} = \beta_{0j} + \gamma_{ij}$

Level-2: (School Level) $\beta_{0j} = \gamma_{00} + \gamma_{01}\mathrm{SCHSIZE} + \gamma_{02}\mathrm{SCHSIZE}^2 + \mu_{0j}$

Model 3: Based on Model 2-b, adding variables *Gender, Ethnic Group, SES, School SES, School District, School Type* into the Model:

Level-1: (Student Level)

http://dx.doi.org/10.15405/epsbs.2017.10.21
Corresponding Author: Yufang Bian
Selection and peer-review under responsibility of the Organizing Committee of the conference
eISSN: 2357-1330

$Y_{ij} = \beta_{0j} + \beta_{1j}SES + \beta_{2j}Gender + \beta_{3j}ETHGRO + \gamma_{ij}$

Level-2: (School Level)

$\beta_{0j} = \gamma_{00} + \gamma_{01}SCHSIZE + \gamma_{02}SCHSES + \gamma_{03}SCHDIS + \gamma_{04}SCHTYPE + \mu_{0j}$

$\beta_{1j} = \gamma_{10}$; $\beta_{2j} = \gamma_{20}$; $\beta_{3j} = \gamma_{30}$;

μ_{0j} is the random effects of Level 2, the mean is 0, and the variance is τ_{00}.

6. Findings

6.1. The influence of school size value-added scores to the school

- **Analysis about Null Model results and the relationship between school size and school value-added scores**

From the Null Model, we get the results and find the relationship between school size and school value-added score analysis as follows:

Table 03. Model 1-a Results (Null Model) Final Estimation of Fix Effects

	Estimation	Standard Error	P-value
For INTRCPT1, β_0			
Intercept 2 γ_{00}	11.908	0.128	0.000***

Table 04. Model 1-a Results (Null Model) Final estimation of variance components

Random Effect	Standard Deviation	Variance Component	P-value
For INTRCPT1, β_0	4.769	32.743	0.000***
Level-1 **r**	9.720	84.480	

From table 04, we can calculate that ICC = 27.932%, students' value-added scores about 27.932% of the total variation is caused by the differences between schools, and individual differences between students accounted for about 72.068%.

Based on Model 1, we add school variables in Level-2 of Model 2, and we get the results as follows:

Table 05. Model 2-a Results Final Estimation of Fix Effects

	Estimation	Standard Error	P-value
For INTRCPT1, β_0			
Intercept 2 γ_{00}	12.374	0.213	0.000***
SCHSIZE, γ_{01}	0.160	0.022	0.004**

Table 06. Model 2-a Results Final estimation of variance components

Random Effect	Standard Deviation	Variance Component	P-value
For INTRCPT1, β_0	4.756	32.624	0.000***
Level-1 **r**	9.720	84.480	

http://dx.doi.org/10.15405/epsbs.2017.10.21
Corresponding Author: Yufang Bian
Selection and peer-review under responsibility of the Organizing Committee of the conference
eISSN: 2357-1330

In the Model 2-b, we add variables school size and school size square, and the results are as follows:

Table 07. Model 2-b Results Final Estimation of Fix Effects

	Estimation	**Standard Error**	**P-value**
For INTRCPT1, $\boldsymbol{\beta_0}$			
Intercept 2 $\boldsymbol{\gamma_{00}}$	13.090	0.384	0.000^{***}
SCHSIZE, $\boldsymbol{\gamma_{01}}$	0.161	0.079	0.003^{**}
$\mathbf{SCHSIZE^2}$, $\boldsymbol{\gamma_{02}}$	0.007	0.003	0.014

Table 08. Model 2-b Results Final estimation of variance components

Random Effect	**Standard Deviation**	**Variance Component**	**P-value**
For INTRCPT1, $\boldsymbol{\beta_0}$	4.747	32.537	0.000^{***}
Level-1 **r**	9.720	84.480	

From table 05 to table 08, we find that there is a significant negative linear relationship (table 07) between school size and value-added scores (γ_{01}= -0.241^{**}). Therefore, the larger the school size, the lower the value-added scores; while in model 2-b, we didn't find a significant relationship between school size square and value-added scores (γ_{02}= 0.007).

6.2. Analysis regarding the influences of school size on value-added scores

The research analysis is based on the linear relationship of school size and the added-value scores. We explore whether there is a critical point of the school size that has influenced the school value-added scores on a changing path.

Table 09. School Size Influence on Added-Value Scores (Standardized Results)

School-Size Classification	**Not Adding Control Variables (Model 2-a)**					**Adding Control Variables (Model 3)**				
	Ⅰ	**Ⅱ**	**Ⅲ**	**Ⅳ**	**Ⅴ**	**Ⅰ**	**Ⅱ**	**Ⅲ**	**Ⅳ**	**Ⅴ**
	Est. (S.E.)	**Est. (S.E.)**	**Est. (S.E.)**	**Est. (S.E.)**	**Est. (S.E.)**	**Est. (S.E.)**	**Est. (S.E.)**	**Est. (S.E.)**	**Est. (S.E.)**	**Est. (S.E.)**
S1vs.S6	-4.559^{**} (0.722)					-2.648^{*} (0.705)				
S2vs.S6	-3.229^{*} (0.728)					-3.260^{*} (0.735)				
S3 vs.S6	-3.229^{**} (0.838)					-2.209^{**} (0.749)				
S4 vs.S6	-1.013 (0.645)					-1.063 (0.761)				
S5 vs.S6	-1.012 (0.642)					-1.057 (0.655)				
S1 vs.S5		-2.241^{**} (0.737)					-2.245^{**} (0.746)			
S2 vs.S5		-2.209^{*} (0.840)					-2.122^{*} (0.753)			
S3 vs.S5		-2.146^{*} (0.751)					-2.140^{*} (0.859)			
S4 vs.S5		-1.010 (0.696)					-1.080 (0.523)			
S1 vs.S4			-2.192^{*} (0.652)					-1.097 (0.759)		

http://dx.doi.org/10.15405/epsbs.2017.10.21
Corresponding Author: Yufang Bian
Selection and peer-review under responsibility of the Organizing Committee of the conference
eISSN: 2357-1330

S2 vs.S4			−2.165* (0.764)					−2.163* (0.767)		
S3 vs.S4			−2.192* (0.784)					-2.019 (0.785)		
S1 vs.S3				−2.003* (0.706)					-1.115 (0.737)	
S2 vs.S3				-1.158 (0.608)					-1.165 (0.510)	
S1 vs.S2					-1.109 (0.727)					-1.401 (0.697)

As table 09 shows, on the two different conditions: No-Adding control variables and Adding control variables, we constructed five models (Ⅰ-Ⅴ) respectively, which compare the different effects of school sizes on the students' Mandarin competency added-value scores. So, we find that when school size reaches a point, the effects are significantly different in statistics.

In Model 2-a (no-adding control variables), we find that size 1, size 2, and size 3 vary significantly between different schools compared to size4, size 5, size 6. Schools with size 1-3 are significantly lower than those schools with size 4-6 on the added-value scores of the Mandarin competency tests. We didn't find a significant difference between schools with size 4-6, and there was no significant difference between schools with size 1-3 in the research either. On the no-adding control variables condition, there is a critical value between size 3 and size 4 (size = 810 students), the schools with size > 810 students get a higher added value than the schools with size ≤ 810 students. However, on the adding control variables condition, after we added the school district, the school social-economic status, the school teaching type into the school model, added gender, ethnic group, and family social-economic status into the student model, we found that there were no significant differences between different school sizes.

7. Conclusion

7.1. The relationship between school size and Mandarin competency test

Research has shown that there is a positive linear relationship between school size and Mandarin scores, so the greater the school size is the higher the added-value scores are. While this result is incompatible with what the previous studies showed, it is consistent with other findings in this area. Schreiber (2002) studied the effects of school size, gathering students' scores of 1839 students in TIMSS test from 162 schools, and the result showed that larger school size is associated with higher academic achievement. In 2003, the research conclusion of PISA has also shown that there is a significant positive correlation between school size and academic achievement. Considering the status quo of the bilingual ethnic groups teaching in China, compared to the smaller schools, the immediate cause of larger-size primary schools' Mandarin performance may be better because it has better teaching conditions, students with a better status background, a higher amount of quality teachers, however, this still needs more evidence through further research.

http://dx.doi.org/10.15405/epsbs.2017.10.21
Corresponding Author: Yufang Bian
Selection and peer-review under responsibility of the Organizing Committee of the conference
eISSN: 2357-1330

7.2. The effects of school size borderline for the school added-value scores

Focusing on the school size borderline, we found that it is consistent with the pursuit of increasing the educational efficiency and quality. In our research, for Mandarin added-value scores, under the no-controlling variables condition, students' academic performance in schools of more than 810 students had significantly higher added-value scores than their peers in the schools of less than 810 students. This means that 810 students could be the borderline of Mandarin added-value, however, 810 is the minimum number of school size. But after adding the controlling variables (family social economic status, gender, ethnics into the student level; and we add school social economic status, school district, school teaching type into the school level), the borderline vanished. The result is very different from Kenneth's (2009) statement that 500 was the borderline.

Although some valuable conclusions are obtained in this research, the present situation of bilingual education in ethnic primary schools in China is complex. Further exploration and discussion are needed. In ethnic minority areas in China, the government tends to invest more on larger primary schools, so larger ethnic schools' educational conditions will be better than smaller ones with richer resources. This means that there are other factors that could mediate or moderate the relationship between school size and Mandarin added-value scores.

References

Andrews, M., Duncombe, W., & Yinger, J. (2002) Revisiting economies of size in American education: Are we any closer to a consensus? [J]. *Economics of Education Review*, 2002, (21).

Bradley, S., & Taylor, J. (1998) The effect of school size on exam performance in secondary schools [J]. *Oxford Bulletin of Economics and Statistics*, 1998, (3).

Eberts, R. W., Schwartz, E. K., & Stone, J. A. (1990) School reform, school size and student achievement [J]. *Economic Review,* 1990, (2).

Jacob, W. (2009) The Impact of high school size on math Achievement and dropout rate [J]. *The High School Journal*, 2009, (3).

Kenneth, L., & Doris, J. (2009) A review of empirical evidence about school size effects: A policy perspective [J]. *Review of Educational Research,* 2009, (1).

Kenneth, L., & Doris, J. (2009) A review of empirical evidence about school size effects: A policy perspective [J]. *Review of Educational Research*, 2009, (1).

Kiesling, H. (1968) High School Size and Cost Factors [M]. Washington, DC: U.S. Department of Health, Education and Welfare, Office of Education, Bureau of Research, 1968:1-150.

OECD (2012) Scaling Procedures and Construct Validation of Context Questionnaire Data [R]. Source *OECD Education & Skills*, 2012, (3).

OECD. (2004) Learning for Tomorrow's World First Result from 2003[R]. OECD Publishing, 2004: 255-260.

Sadoski, M., & Willson, V. L. (2006) Effects of a theoretically based large- size reading intervention in a multicultural urban school district [J]. *American Educational Research Journal, 2006*, (1).

Sawkins, J. W. (2002) Examination performance in Scottish secondary schools: An ordered logic approach[J]. *Applied Economics*, 2002, (34).

Schreiber, J. B.(2002) Institutional and student factors and their influence on advanced mathematics achievement[J]. *Journal of Educational Research*, 2002, (95).

William, J. F., William, J., & Walberg, H. J. (1991) school size, characteristics and outcomes [J]. *Educational Evaluation and Policy Analysis, 1991*, (2).