Educational Inequality Analysis: International Comparison*

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Abstract

Educational inequality is the common issue all over the world. We choice the 28 educational indicators published by international organizations, and use the factor analysis to build the educational inequality indicators system. Then we explore the impact factors of educational inequality by the principal component analysis, and make the comprehensive evaluation for 38 countries.

Keywords：Educational inequality, PISA, GED, Factor analysis, Comprehensive rank

1. Introduction

The education inequality is one of the common issues all over the world. The early research about the education equal focused on educational opportunity equalization which refers to every person has the same education right and all social groups will be provided equal educational opportunities. As society development, people pay more attention to educational inequality and the resulting series of social problems. To eliminate educational inequality and realize education equality, the mechanism and related theories of education inequality are explored, such as the Riesman's "cultural deprivation" (Riessman, 1962), Bowles and Gintis's "theory of social reproduction"(Bowles & Gintis,1976;1980) and so on. These theories indicated that the family Economic Social and Cultural Status (ESCS), public education resources distribution and parental education level are all important factors affecting education equality.

In order to compare the development of education process over the world, education evaluation and related statistical databases have been established by many international organizations, such as The World Bank "World Development Indicators", UNESCO "Global Education Digest", OECD "Education at a Glance" and "Project for International Student assessment (PISA)" and so on. Applying the above data, the researchers have done a lot of work about the international education inequality comparison. Some scholars "*agree that education systems that are 'equitable' provide high-quality education to all children, regardless of their background or where they live*"，and measured educational equity in 16 of the largest, most-populous countries using the enrollment ratio, expenditure per pupil and pupil-teacher ratios (Sherman and Poirier, 2007). Some researchers, using education Gini and Theil indices compare the distribution of education attainment for 140 countries between 1960 and 2000 (Thomas, Wang & Fan, 2000; 2002). Others made measurement and analysis educational inequality in the special area, such as in Latin America and Sub-Saharan Africa countries (Frankema & Jutta, 2006). There are 68 countries and regions that participated PISA in 2006.

The international comparative studies based on 2006 PISA have the encouraging conclusion which is "*comparison of the relationship between student performance and different aspects of socio-economic background shows that some countries simultaneously demonstrate high average performance together with similar outcomes among students from different socio-economic backgrounds. These countries set important benchmarks of what can be achieved in terms of the quality and equity in learning outcomes*" , and "*the results suggest therefore that quality and equity need not be considered as competing policy objectives*"(OECD, 2007a).

Professor Andy Green, from the education on the role of social cohesion, analyzed the educational inequality differences across countries, and proposed that "*policies to increase social cohesion through education must pay more attention to the reduction of educational equality than they currently do*" (Green, Preston & Janmaat, 2006). There are many literatures about the education inequality research in China. Some focused on the building educational inequality indicators in China (Li, 2006; Yang & Zhou, 2003). Some used the Gini coefficient to measure the Chinese education inequality, and indicated that "*education inequality of China has been declining from 1982 to 2000. The education Gini coefficient is negatively associated with average years of schooling and secondary school enrollment ratio. In addition, the higher per capita GDP is most likely to achieve better education equality than those low per cap ita GDP, but gender-gap in illiterate ratio gets large*" (Nie, 2006).

Others also used Ggini coefficient to measure education inequality for 31 provinces in China during 1996～2004. The results showed that the education expansion policy yielded an excellent effect, it significantly improved education disparity among regions, and education inequality will block economic growth, and it has become an important factor to cause the economic discrepancy over regions (Yang & Li, 2007) These studies involved international and interprovincial education inequality in China. However, the used indicators were relatively single, and the evaluation approach is also comparatively simple. Besides the introduction, this paper include the following section, the second section is the education inequality indicators and measurement method. In the third and forth sections, the relative factors which impact the education inequality will be probed, and the comprehensive evaluation of the international education inequality are obtained in 38 countries. The last section is the conclusion.

2. International Education Inequality Factor Analysis

2.1 Data sources and indicators of educational inequality

To compare the educational inequality between countries, we selected a variety of education indicators published by the world organization. At first, most indicators and data in this paper are from the 2006 PISA analysis report which contains a large number of student socio-economic background and school socio-economic background data (OECD, 2007b). Secondly, national education enrollment, expected education years and government investment data the statistical from the UNESCO institution for statistic (UNESCO, 2007a; 2007b).The ratio of national public education investment in GDP and fiscal expenditure from the "Human Development Report" in UNDP (UNDP, 2007). Combining educational evaluation indicators from the three world organizations, we chose the 25 indicators to build the framework to measure the educational inequality in 38 countries.

2.2 Based on principal component analysis method

In order to analyze differences in educational inequality between countries, we selected the factor analysis method and used SPSS 17.0 software (Guo, 2001). Using the principal component analysis, we obtained the main five factors, and finally calculated the national education inequality comprehensive evaluation index according to the difference contribution value as the size of the weight (See table 1).

2.3 Factor analysis result of educational inequality

The selected 25 variables has the very high correlation coefficient, the Bartlett's Test of Sphericity is 1219.999, and the probability p-value is closed to 0, KMO Measure of Sampling Adequacy is greater than 0.7. All tests indicate that these data are suitable for factor analysis. Though the principal component analysis and varimax with Kaiser Normalization rotation, we obtained five main factors from 25 indicators. The front five eigenvalues interpreted the original variable standardized variance of 82.87 percent in the variable correlation matrix, so we could choose these five main factors which impact the education inequality ingredients divided into five categories.

3. Factors impacting on the education inequality

Based on the above factor analysis, these five factors could be considered the impacting on educational inequality. Now we analyze these factors difference across the countries.

3.1 Social-economic status differences

The first principal component explained variance contribution rate is 22.44 percent, and there are eight indicators which their loadings are greater than 0.5. It included the "with-school and between-school variance in student performance on the science, mathematics and reading scale explained by the PISA index of ESCS of students and schools in PISA 2006" and "student-level and School-level science score point difference associated with one unit of the student-level within-school and the school mean effects of ESCS".

The eight indicators mainly focus on the students within- school and between-school economic, social and cultural status differences influencing the student performance on science, mathematics and reading. Therefore, we named the first factor "social-economic status differences (SESD)". The first factor mainly reflected the education inequality though the students and the schools different economic, social and cultural status. The students of economic, social and cultural status in 2006 PISA include household wealth, parents' highest occupational status and parents receiving the highest education level, etc.. The index was derived from the Item Response Theory (IRT), and was different from principal component analysis previous years (OECD, 2007a).

Since the factor loading of between-student is greater than the between-school, so the economic, social and cultural status differences between students is bigger than differences between schools. ESCS is always the major ingredient which impacts the inequality of education around the world. Because the Principal Component Index (PCI) mean is zero. If PCI equals zero, the national sample locates the average level of educational equality. There are 20 countries of the PCI is greater than zero, it indicates that the degree of education equality in these countries is more than the average level. Such as Poland, New Zealand, the United States, Spain and the UK are the largest five countries, and it indicates that students between individuals and between schools of ESCS are relative small differences in these countries. On the contrary, Japan, Slovenia, Hungary, Austria and the Netherlands are negative and listed in last. It made clear that education inequality from the students ESCS was quite significant.

3.2 Occupational and cultural possessions differences

The second principal component explained variance contribution rate of 20.82 percent. There are five projects which their factor loading are greater than 0.5, and they are arranged by the size of loading: "International socio-economic index of occupational status (HISEI) and performance on the science scale", "Difference in science performance between students with a more advantaged PISA index of ESCS and students with a less advantaged PISA index of ESCS", "Difference in science performance between students with white-collar high-skill parents and students with blue-collar low-skill parents", "Science score point difference associated with one unit on the Within-school effects of ESCS", and "Percentage of students and performance on the science scales by level of cultural possessions at home". So the second factor named "occupational and cultural possessions differences (OCPD)".

The parental occupational status and the cultural possessions at home are also the main factors impacting the education equality. *The international socio-economic index of occupational status was derived from students' responses on parental occupation. The index captured the attributes of occupations that convert parents' education into income. The index was derived by the optimal scaling of occupation groups to maximise the indirect effect of education on income through occupation and to minimise the direct effect of education on income, net of occupation (both effects being net of age). The index of cultural possessions at home was derived from students' reports on the availability of the following items in their home: classic literature (examples were given), books of poetry and works of art (examples were given)*(OECD, 2007a). There are 18 countries in the indicators value greater than zero, is higher than average level. Indonesia, Korea, Finland, Latvia and Russia are list in the front five, and the education equality is relative right in the five countries. On the contrary, the Czech Republic, New Zealand, the United States, Belgium and Croatia have the larger inequality degree in the last five ranking.

3.3 Education enrollment and resource differences

The third factors include six projects named "education enrollment and resource differences (EERD)". It main comprised the "percentage of students and performance on the science scales by level of fathers' and mother' education and by level of home educational resources", education expected years and the mass enrollment ratio of secondary school and higher education. There are 23 countries which the PCI value are greater than zero, are higher than average. The top five countries are Finland, Australia, Japan, Denmark and Norway, while in the last five in Chile, Indonesia, Tunisia, Mexico and Thailand (See chart 1). It shows that enhancement the secondary and higher education enrollment and increasing education expected years could eliminate the education inequality.

3.4 Government education investment and parental education level differences

The fourth and fifth of the contribution rates were 11.46 percent and 9.03 percent, their loading factor are greater than 0.5 project were 4 and 2. We separately named "government education investment differences (GEID)" and "parental education level differences (PELD)". The fourth factor influencing education inequality is the government education investment. We focused on the ration of financial investment on the GDP and the public expenditure.

The top 5 countries are Tunisia, Mexico, Denmark, Norway and Sweden, and the latter 5 countries are Japan, Greece, Russia, Uruguay and Indonesia. Just only 17 countries are bigger than zero, the surplus 21 countries PCI value is smaller than the average value. It indicates that the government educational investment level is the major reason to impact the education inequality.

4. International education inequality comprehensive value

In the above 5 factors analysis, we obtained an appraisal education inequality comprehensive index (See chart 2). There are twenty countries comprehensive index scores (CIS) are greater than zero. And the comprehensive index rank (CIR) top 10 countries are in turn: Finland, Sweden, Norway, Denmark, Estonia, Latvia, Australia, Spain, Ireland and New Zealand. It may consider that the education is relative equality in these countries. From 11 to 20 middle position countries are South Korea, Lithuania, Switzerland, Tunisia, Russia, Israel, Britain, Poland, the US and Mexico. The score in these countries are also positive, indicates the education equal degree in above all sample country is greater than the mean value. The last 10 countries are Austria, Belgium, Holland, Argentina, Thailand, the Slovenia, Slovakia, Czechoslovakia, Hungary and Chile. Their principal components index is negative, and it indicated that the education inequality degree is lower than the average level.

In Finland, its comprehensive index is the first. It shows the education is very equality in this country. Its "education enrollment and resource" and "occupational and cultural possessions" are located separately at first and third. However, ESCS between the students and the schools occupies the 11th in all 38 sample countries, and "government education investment and parental education level" located at the 10th and 14th. Since the two latter factors weight is relatively low, it could not weaken the whole rank. Obviously, enhancing the national education equality degree, we need to pay more attention to each factor and the overall efficiency, and cannot only pursue one indicator. Chile is the last country which comprehensive evaluation index is negative 74.25. The all 5 factors scores are negative, and its educational inequality degree is the highest country.

5. Conclusion

Through the above study, we may obtain the following conclusion:

Firstly, from the comprehensive index scores, education inequality degree is various in sample countries, it may be divided into four levels: the higher degree, high, low and the lower. The education equality level is higher countries which their comprehensive index is in the top 10, and their index scores are greater than twenty-two.

On the contrary, the low degree of educational equality is ranked number in the bottom 10, and their index scores are less than negative 26. The formative reasons of educational inequality are different in these countries, according to the respective sub-index we could find the main factors and make appropriate policy to reduce the educational inequality.

Secondly, the most important factor affecting educational inequality is the differences of economic, social and cultural status (ESCS) between students and schools. To reduce the gap of educational inequality between students and schools ESCS is difficult to be changed in the short term, however, the differences can be realized through the education system reformation by government so as to provide the more equal chance.

Thirdly, the government educational investment difference is the other key factor what forms the education inequality. The high proportion of the government education financial needs the favorable external environment which could promote the education equality. For example, Tunisian this indicator located at first in all sample countries, however, its "education enrollment and resource" and "social economy status" location are relative backwardness, so the education financial investment did not causes reducing the education inequality effect.

In short, the educational inequality in the world is an eternal issue. This study to build the educational inequality indicators system explored five factors which impact on the education inequality in various countries. Though the comprehensive index, we provide a benchmark to scale the educational inequality degree for sample counties.

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Table1 the indicators weight of education inequality

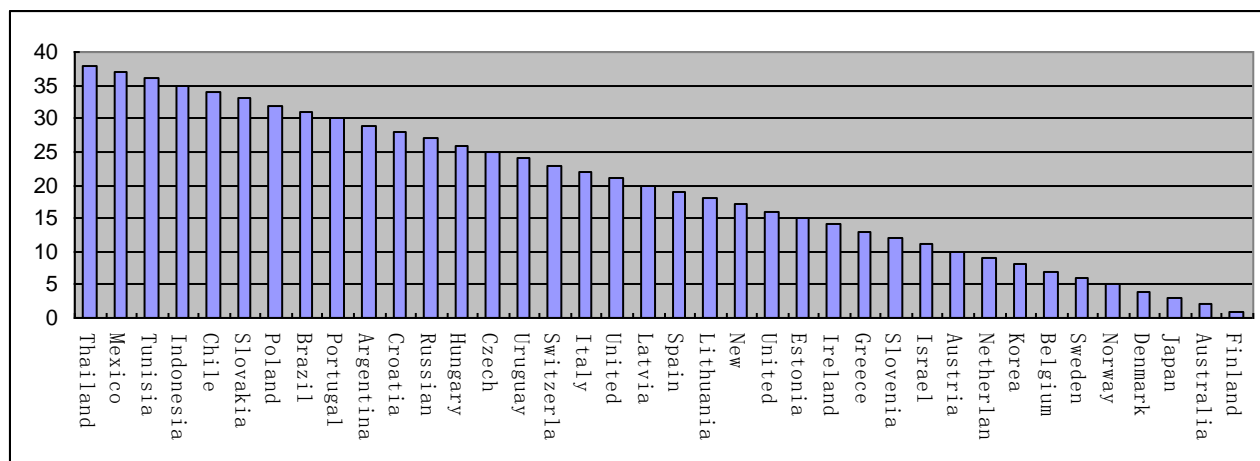| Component	Initial Eigenvalues	Rotation Sums of Squared Loadings	Cumulative
1	5.611	22.444	22.444
2	5.206	20.822	43.266
3	4.780	19.120	62.386
4	2.864	11.457	73.843
5	2.257	9.026	82.869

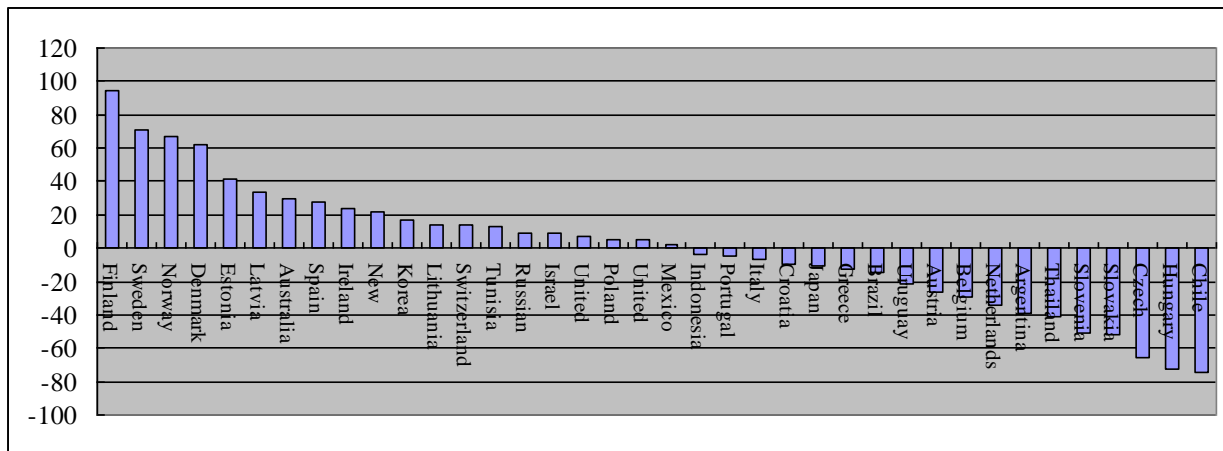**Chart 1 Education enrollment and resource differences rank**

Chart 2 Education inequality comprehensive index scores

Table 2 International Educational Inequality Comprehensive Evaluation

countries	SESD	1	OCPD	2	ERRD	3	GEID	4	PELD	5	CIS	CIR
Australia	0.60	12	0.04	17	1.47	2	-0.83	32	-0.38	27	29.39	7
Austria	-1.51	35	-0.84	29	0.59	10	0.38	13	1.01	8	-26.48	29
Belgium	-1.23	33	-1.19	35	0.87	7	0.67	8	-0.13	23	-29.26	30
4Czech	-0.95	30	-1.66	38	-0.23	25	-0.52	28	0.12	18	-65.28	36
Denmark	0.93	6	0.17	15	1.15	4	1.42	3	-0.11	22	61.73	4
Finland	0.69	11	1.63	3	1.83	1	0.66	10	0.29	14	94.47	1
Greece	-0.33	25	-0.14	20	0.46	13	-1.09	35	0.20	15	-12.23	26
Hungary	-1.57	36	-1.01	32	-0.27	26	0.17	16	-1.40	35	-72.21	37
Ireland	0.79	8	0.16	16	0.44	14	-0.38	25	-0.17	24	23.52	9
Italy	-0.99	31	0.47	12	0.10	22	-0.46	27	0.98	9	-7.01	23
Japan	-1.77	38	1.22	6	1.36	3	-1.06	34	-1.08	33	-10.22	25
Korea	-1.18	32	1.88	2	0.80	8	-0.11	21	-1.12	34	16.80	11
Mexico	-0.26	24	0.73	11	-1.87	37	1.45	2	1.33	3	2.28	20
Netherlands	-1.33	34	-0.91	30	0.75	9	-0.05	18	0.08	20	-34.32	31
New Zealand	2.00	2	-1.51	37	0.33	17	0.44	12	-0.32	26	22.17	10
Norway	0.77	9	0.74	10	1.09	5	1.14	4	0.09	19	67.30	3
Poland	2.20	1	-0.15	22	-1.04	32	-0.11	22	-2.20	38	5.13	18
Portugal	0.74	10	-0.54	24	-0.87	30	0.25	14	0.44	13	-4.48	22
Slovakia	0.30	17	-0.93	31	-1.17	33	-0.67	30	-0.97	31	-51.53	35
Spain	1.17	4	0.35	14	0.21	19	-0.98	33	0.13	17	27.50	8
Sweden	0.81	7	0.39	13	1.05	6	1.12	5	1.24	4	70.42	2
Switzerland	0.35	15	-0.72	26	0.02	23	0.85	7	1.20	5	13.85	13
United kingdom	0.95	5	-1.10	33	0.35	16	-0.26	24	0.50	12	6.79	17
United states	1.42	3	-1.25	36	0.16	21	0.10	17	-0.59	29	4.72	19
Argentina	-0.34	26	-0.83	28	-0.58	29	-0.71	31	0.56	11	-39.01	32
Brazil	-0.19	23	-0.14	21	-0.99	31	-0.60	29	2.05	1	-14.59	27
Chile	-0.49	28	-1.13	34	-1.37	34	-0.40	26	-0.98	32	-74.25	38
Croatia	-0.49	27	0.03	18	-0.33	28	-0.19	23	1.05	7	-9.31	24
Estonia	0.24	18	1.18	7	0.40	15	0.19	15	0.20	16	41.50	5
Indonesia	0.01	20	1.98	1	-1.43	35	-2.46	38	1.16	6	-3.58	21
Israel	-0.16	22	-0.30	23	0.55	11	0.98	6	-0.31	25	9.17	16
Latvia	0.34	16	1.35	4	0.17	20	-0.07	20	-0.58	28	33.10	6
Lithuania	0.48	13	-0.04	19	0.24	18	-0.06	19	0.03	21	14.33	12
Russian	0.44	14	1.34	5	-0.32	27	-1.20	36	-0.94	30	9.39	15
Slovenia	-1.76	37	-0.58	25	0.49	12	0.67	9	-1.81	36	-50.79	34
Thailand	-0.12	21	1.02	9	-2.56	38	0.53	11	-1.86	37	-41.01	33
Tunisia	-0.72	29	1.07	8	-1.84	36	3.06	1	0.79	10	13.19	14
Uruguay	0.14	19	-0.78	27	-0.02	24	-1.86	37	1.51	2	-21.18	28