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Important Factors in Child's Academic Performance

Aakanksha Kaushik
Assistant Professor (Ad-hoc), Maitreyi College, Delhi University, India

Abstract:
This study was conducted to examine factors influencing the academic performance of children at pre-primary level in three states of India, namely Rajasthan, Assam and Andhra Pradesh. For the analysis Multinomial Logistic regression was run on primary data collected from these three states. The results of the analysis highlights the significance of Mother's education, public sector schools and Learning Play aids on child's academic performance. The analysis not only confirmed the key significance of mother's education and learning play aids, but it also showed the importance of public sector schools and Anganwadis at pre-primary levels in rural areas of India.

1. Introduction

Policy-making on education is crucial for every country's present and future. There are many domains in the policy making on education. In this study, we have analyzed the different factors that influence child's academic performance at pre-primary levels.

The study was based on 4-5-year-old children born between March, 2007 and February, 2008 and they were followed up for a year. The large survey based on systematic random sampling was conducted and samples were collected from rural areas of two districts each in three Indian states (Rajasthan,Assam and Andhra Pradesh).

Student's test was a comprehensive one, assessing children on their language and cognitive skills. Children's gain in academic performance in one year was analyzed and an attempt was made to decipher the factors influencing it. For this purpose, children were divided into three categories on the basis of their gain in one year, viz. Highest gain, Average gain and Lowest gain category.

For the analysis Multinomial Logistic Model was used. "Multinomial logistic regression is used to predict the categorical placement in or the probability of category membership on a dependent variable based on multiple independent variables" (Starkweather and Moske, 2011). Multinomial logistic regression with 'Gain in academic performance' as the dependent variable was run. As discussed earlier, there were 3 outcomes/ categories in which 'Gain' was divided and 'Highest gain category' was chosen as the base category.

This study has tried to analyze the following factors:

1) The impact of the well-documented effect of 'Mother's education' on the child's academic outcome in India.
2) The comparison of private sector and public sector schools at pre-primary level in rural India.
3) The impact of learning through play and use of playing aids in classroom.

This paper is organized as follows. Section II provides an overview of studies on factors affecting children's academic achievements. Section III describes the data and methodology used in the paper. Section IV discusses the results derived from the multinomial logistic regression.

2. Literature Review

Around the world, researchers have increasingly tried to assess the factors influencing the educational processes and academic achievements. The researches differ on the waysof measuring academic achievement, the factors observed for the analysis and the methodology adopted for analysis.

In educational researches, many variables have been observed but the most widely used variable is Socio-Economic Status (SES). Sirin (2005) reviewed studies published between 1990 and 2000 using meta-analysis. He concluded the SES-achievement correlation is significant but has declined over the years. He also observed that assessing student's family background regardless of the main research focus is must and it is the key to understanding success in school.

Within socio-economic variables, mother's education has attained great importance. Maternal education is crucial for societal transformation and it has an impact on child's health and his/her academic performance also. Carneiro et al. (2011) findings showed that mother's education increases the child's performance in both math and reading at ages 7-8, but these effects tend to be smaller at ages 12-14. The study also showed that maternal education also reduces the incidence of behavioral problems and reduces grade repetition. Dubow et al. (2011) analyzed data from Columbia County Longitudinal Study, a 40-year developmental study initiated in

1960 with data last collected in 2000 suggested that the beneficial effects of educational level of parents when the child is young are not limited to academic achievement throughout the school years, but have long-term implications for positive outcomes into middle adulthood.

The other important question concerning academic outcomes has to do with the social choice of public versus private sector schools. It is believed by some that private schools give better educational performance. But the researches in this domain have given conflicting results across the globe. Researches in India, Bashir 1994, 1997; Govinda and Varghese 1993; Kingdon 1994, 1996b; Tooley and Dixon 2003 have all suggested that the private school's academic performance is better. But Murnane et al. (1985) Lubienski, S. and Lubienski, C. (2006) and Goldhaber (1999) are some of the researches which have suggested that the problem of "student selection" is crucial to assess the academic impact of choice. Student demographics in various sectors is an important factor in determining performance. Lubienski S. and Lubienski C. (2006) findings showed that "the relatively high raw scores of private schools were more than accounted for by student demographics. In fact, after demographic differences had been controlled, the private school advantage disappeared and even reversed in most cases." Arum (1996) attempted to answer the question: "Do private schools force public schools to compete in US?" The study concluded that the performances of public school students have increased. The increase has been attributed to increased resources provided to public schools and not organizational efficiency.

Theory suggests that at pre-primary levels the significance of learning with playing and learning aids is immense. Vygotsky (1976) stated that "Play is the leading source of development in the early years". Ginsberg (2007) stated that "Play allows children to use their creativity while developing their imagination, dexterity and physical, cognitive and emotional strength." Hence, accommodating for this aspect in the model is crucial.

3. Data and Methodology

As mentioned earlier, primary data collected by Center for Early Childhood Education and Development, Ambedkar University, Delhi was used for this study. The districts sampled were Medak and Warangal in Andhra Pradesh, Dibrugarh and Kamrup in Assam and Ajmer and Alwar in Rajasthan. The large survey based on systematic random sampling was conducted. Children born in the age group of 3 years 6 months and 4years 6 months (born between March, 2007 and February, 2008) were selected as samples; total sample for the study was 2282 and they were selected from ICDS survey records.

Children were selected from different types of early education centers, viz. Anganwadis, Private Preschools, Preschools run by NGOs and government primary schools. Even though children were below prescribed age for government primary schools but somehow they were attending these schools regularly and were made part of the sample.

Household characteristics of the sample such as social indicators, economic indicators, mothers' education, etc. were collected through household survey questionnaire, which was administered during the home visit. As mentioned earlier, the academic performance was gauged through a test developed & standardized by The World Bank in 2009 according to Indian conditions. This test was a comprehensive one, assessing children on their language and cognitive skills. Children were evaluated according to this test twice in the gap of one year. The test taken at starting of the session was called pre-test and the test taken at the end of the session was called post-test. The difference between the scores of post-tests and pre-tests gave us the gain in the academic performance. From this gain, we constructed a new variable 'Gain category', which was obtained by categorizing gain into three categories- Highest gain, Average gain and Lowest gain.

For the categorical dependent variable 'Gain Category', we run multinomial logistic regression. In any multinomial logistic regression, If there are J number of response categories for variable Y and $\pi_1, \pi_2, \ldots, \pi_J$ are the probabilities for arandomly chosen individual to fall into categories 1, . . . , J, respectively. Then $\sum \pi_i = 1$. In this modeling we are interested in finding if certain predictors havean effect on the probabilities $\pi 1, \ldots, \pi J$. In multinomial logit models we model simultaneouslyall relationships between probabilities for pairs of categories; this is done by modeling the odds of falling within one category instead of another.[1] In our case we are modeling the odds of falling in any gain category instead of highest gain category. The reason of using this technique was that the basic assumptions of normality and continuous data were not associated with it.

If the last category (J) is the baseline category, then the coefficients of logistic regression are

$$\log\left(\frac{\pi_i}{\pi_J}\right), i = 1, 2, \ldots, J-1$$

The model with k explanatory variables is then

$$\log\left(\frac{\pi_i}{\pi_J}\right) = \alpha_i + \beta_{1i}X_1 + \beta_{2i}X_2 + \ldots + \beta_{ki}X_k$$

$$i = 1, 2, \ldots, J-1 \; categories \; and \; k = 1, 2, \ldots, K \; explainatory \; variables$$

For this study, we have estimated the following equation through STATA 10.1 statistical software:

$$\log\left(\frac{\pi_i}{\pi_{High}}\right) = \alpha_i + \beta_{1i}Mother's\_Education + \beta_{2i}Public\_Sector\_School + \beta_{3i}Learning\_Play\_aids + \beta_{4i}Rajasthan$$

i= low gain category or average gain category.

[1] http://academic.macewan.ca/burok/Stat371/notes/multicategory.pdf

In this regression, there are three categorical variables ($Mother's\_Education$, $Govt\_School$ and $Rajasthan$) and one continuous variable ($Learning\_Play\_aids$). Where *'Mother's_Education'* was 1 for 'Illiterate' mothers and 0 for 'literate' mothers, *'Public_sector_School'* was 1 for students attending Anaganwadis and government primary schools and 0 for private schools and *'Rajasthan'* was 1 for students from Rajasthan and 0 for students from Assam and Andhra Pradesh.For children who have illiterate mothers, the estimated odds of belonging to lower gain categories rather than high gain category are $\exp(\beta_{1i})$ times those for children who have literate mothers, controlling for all other factors. On the same lines all other beta coefficients for categorical variable can be interpreted. *'Learning_Play_aids'* was the continuous score given to each schoolfor their effort in learning with playing and aids provided to the student at pre-primary level. This score was given on three main parameters: Availability of space and equipment for outdoor play/ activities for all children, Availability of varieties of equipment/ materials for indoor learning/play activities and Use of indoor learning materials in the class. For score x+1, the estimated odds that child belongs to "low gain category or average gain category" rather than "high gain category" equal $\exp(\beta_{3i})$ times the estimated odds at score x (controlling for other variables). The exponential of the beta coefficients is nothing but the relative risk ratios and they were estimated through STATA 10.1. The results of this estimated regression are discussed in next section.

4. Results and Interpretation

The results of the study are presented in Table 1 :

Iteration 0: log likelihood = -2502.7958					
Iteration 1: log likelihood = -2471.1141					
Iteration 2: log likelihood = -2471.0622					
Iteration 3: log likelihood = -2471.0622					
Multinomial logistic regression				Number of obs	2282
				LR chi2(8) =	63.47
				Prob > chi2 =	0.0000
Log likelihood = -2471.0622				Pseudo R2 =	0.0127
Gain categories	RRR	Std. Err.	Z	P>z	[95% Confidence Interval]
Low Gain Category					
Mother's Education	1.514177	.1786569	3.52	0.000	1.2015551.908136
Public Sector Schools	.6258554	.0715576	-4.10	0.000	0.5002088 0.783063
Rajasthan	.6561298	.0829763	-3.33	0.001	0.512087 0.840689
Learning Play aids	.8850405	.0586051	-1.84	0.065	0.77731811.007691
Average gain category					
Mother's Education	1.525049	.1768238	3.64	0.000	1.2150381.914156
Public Sector Schools	.7833098	.0861678	-2.22	0.026	0.63138940.97178
Rajasthan	.650893	.0801742	-3.49	0.000	0.511284 0.82862
Learning Play aids	.7526512	.050721	-4.22	0.000	0.659525 0.858926
(Gain category == High Gain Category is the base outcome)					

Table 1

The number of observations used in the multinomial logistic regression was 2282. Likelihood Ratio (LR) Chi-Square test that for both equations (low gain relative high gain and average gain relative to high gain) that at least one of the predictors' regression coefficient is not equal to zero was estimated to be 63.47. From the p-value of 0.00 one can conclude that at least one of the regression coefficients in the model is not equal to zero.

For children who have illiterate mothers, the estimated odds of belonging to low gain category rather than high gain category are 1.51 times those for children who have literate mothers, and the estimated odds of belonging to average gain category rather than high gain category are 1.53 times those for children who have literate motherscontrolling for all other factors. Both the beta coefficients were highly significant at 0.00% level of significance.A child born to an illiterate mother was more likely to fall in low gain category. The results show the importance of mother's education on the child's academic performance.

For children from government schools or Anganwadis, the estimated odds of belonging to low gain category rather than high gain category are 0.63 times those for children from private schools, and the estimated odds of belonging to average gain category rather than high gain category are 0.78 times those for children from private schools,controlling for all other factors. The results were significant with 0.00 and 2.6% level of significance respectively. The relative risk ratio was higher for average gain category. The results are very interesting and clearly challenge the notion that private schools are more efficient. The estimated odds suggested that the child from government school or Anganwadi is more likely to belong to high gain category than any of the lower gain categories.

The variable Rajasthan is the qualitative variable introduced in model to capture the geographical differences, if any.For children from Rajasthan, the estimated odds of belonging to low gain category rather than high gain category are 0.66 times those for children from Andhra Pradesh and Assam;and the estimated odds of belonging to average gain category rather than high gain category are 0.65

times those for children from Andhra Pradesh and Assam,controlling for all other factors. The results show that a child from Rajasthan was expected to fall in high gain category.

The relative risk ratio for a one unit increase in 'learning play aid' score for low gain category relative to high gain category given that the other variables in the model are held constant was 0.89 and the relative risk ratio for a one unit increase in 'learning play aid' score for average gain category relative to high gain category given that the other variables in the model are held constant was 0.75. More generally, we can say that the child from the school which was scored high on'learning play aid', will be expected to fall into high gain category as compared to low gain category.

As mentioned earlier, the reason of using this technique was that the basic assumptions of normality and continuous data were not associated with it. But the multinomial model is based on one crucial assumption of Independence of irrelevant alternatives (IIA). The assumption of IIA wasassessed using Hausman test using STATA. The results of the test are presented in table 2 and they clearly show that there has been no violation of IIA assumption.

Hausman tests of IIA Assumption				
H_O: Odds (Outcome-J vs Outcome-K) are independent of other alternatives.				
Omitted	chi 2	df	p > chi2	evidence
Low gain category	-1.950	5	1.000	For H_O
Average Gain Category	0.468	5	0.993	For H_O
High gain category	66.213	5	0.000	Against H_O

Table 2

5. Conclusion

The analysis highlights the significance of 'mother's education', 'public sector schools' and 'learning play aids' on child's academic performance. Importance of mother's education on child's health, nutrition and education is well known. It can also be observed that from the results of this paper that if a child's mother was illiterate then the child was expected to fall in lower gain categories. This paper confirms the significance of mother's education on child's academic performance at pre-primary level.

There are many worries attached to government schools and Anganwadis in India. The most common of them being that there is not much teaching that happens in the government schools. But the results found in this paper were totally contradictory. In rural areas of three states of India, the academic performance of children from government schools or Anganwadis was far better than the low budget private schools at pre-primary levels. In fact, a child from low budget private school was expected to fall in low gain or average gain category.

Another interesting finding of the paper was the importance of learning with play aids. At pre-primary level, learning play aid was one of the most important factors. Increase in learning with play aid score increased the chances of belonging to high gain category.

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