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ABILITY GROUPING IN SCHOOLS: A STUDY OF ACADEMIC ACHIEVEMENT IN FIVE SCHOOLS IN ESTONIA

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Abstract. The paper deals with the questions of the quality of schooling and the effect of ability grouping on students' achievement. One hundred and forty seven children from five schools participated in the study. Two schools were usual mainstream town schools, one a usual rural school, one Step-by-Step school and one "elite" private school. All children were studied twice: at the beginning of the first (age 7) and third grade. First, children's cognitive abilities were assessed; second, their academic achievement in Estonian language and mathematics was assessed. Both the battery of cognitive tests and tasks in achievement test were developed specifically for this study. It was shown that attending an elite private school was related to abilities and higher academic performance of children. However, when both school and average cognitive ability of a school a child was attending were entered into the Multiple Regression analysis for predicting Academic Achievement, attending Elite school had negative impact on Achievement.

Keywords: ability grouping, school effectiveness, prediction of academic performance, 'elite' school, step-by-step

1. Introduction

Republics that have established their independence after the collapse of the Soviet empire face many changes in the structure and functioning of society. Educational system is no exception. In Estonia, one of the Baltic republics, the system of education seems to undergo a never-ending reform. It is not surprising that not only children and parents but also educational authorities are confused and do not know how to cope with the need to make choices in an increasingly complex system of education.

In the Soviet era school choice was a relatively exceptional possibility, especially for children in first four grades. With independence the possibility for school choice grew. Now we have in addition to public mainstream schools public "elite" schools with highly competitive entrance requirements, "alternative" schools (e.g. Waldorf schools), and private schools. In addition, many schools track students into separate “ability” groups. Some (usually public) schools participate in international educational projects that attempt to improve the quality of education in the mainstream system (e.g. Step by Step).

The choices parents must make to find the “best” school for their children are related not only to the quality of education provided by a particular school or some special class in the school but also to financial considerations. By Estonian standards studying in private schools is quite expensive. It is also known that studying in “elite” public schools is related to additional costs for special classes, field trips, additional books, etc. Many families cannot afford all that. In addition, even those families who can pay for education of their children must decide whether the benefits of attending private school or “elite” mainstream school pay off the increased expenses.

Issues related to school choice, school quality and economic aspects of schooling have been extensively studied in many countries. In relation to economic aspects, it has been found in several studies that higher education financing *does not* improve students’ performance on achievement tests *per se* (e.g. Behrman, Khan, Ross, Sabot 1997, Eide 1998, Kirjavainen, Loikkanen 1998, Marlow 2000). What matters is teaching quality, not availability of school equipment and infrastructure (e.g. Behrman et al. 1997). It has been found that pupils gain more from developmentally appropriate practices (Hyffman, Speer 2000). Considering that some private schools may direct their resources more to the development of infrastructure than to the development of schooling ideology and educating teachers, it would not be surprising that their effectiveness is lower than expected. In some studies, indeed, it has been found that, other things equal, private schools are inefficient compared with public schools (Kirjavainen, Loikkanen 1998). When it is beneficial for students, the effect is very small (Stevans, Sessions 2000). Other studies, however, have found that attending the most selective private colleges is beneficial (e.g. Eide, Brewer, Ehrenberg 1998). A fair conclusion seems to be that further studies are needed to understand the potential benefits of school choice (Jeynes 2000).

There is, however, an additional point worthy of attention. The effectiveness of private schools seems to be low or even negative in studies where school output (achievement level, better jobs, higher salaries, etc.) has not been the only measure of school effectiveness. In such studies also school inputs and characteristics, family and student inputs and characteristics, and teacher inputs and characteristics are taken into account. Many studies have shown that the most important factor influencing the effectiveness of a school is students’ social class membership (e.g. Lytton, Pyryt 1998). More specifically, Kirjavainen and Loikkanen (1998) found that the more educated the parents the more effective the school. Better educational level of parents is usually associated with higher abilities of children. It can be expected that private and “elite” schools accept mainly students with high abilities because better education of parents is related to increased family income. In fact, in Estonia, the effect of attending a private school or an “elite” mainstream school is confounded with student selectivity, with ability grouping. Both types of schools explicitly select students on the basis of their abilities. School segregation seems to be increasing in Estonia. Similar tendency of increasing segregation of schools on the basis of students' abilities has been observed in other countries (for France see Broccolichi, van Zanten 2000, Duru-Bellat, Mingat 1998).

Ability grouping has raised several controversial issues, both about its value as an educational practice in democratic societies, but also about its appropriateness as a teaching practice and of its educational outcomes. Its usage is related to segregation, which is inconsistent with democratic ideals. However, ability grouping enables to adapt instruction according to students' ability level, match work to students' needs and interests, provide appropriate tasks both for students with higher and with lower abilities, skills and knowledge (Cheung, Rudowicz 2003, Hallam, Ireson, Davies 2004). In this way, students can benefit from cooperation and mutual facilitation. Additionally, ability grouping facilitates teaching – several studies have found that teachers have positive attitudes towards it (Hallam, Ireson 2003, Hallam, Ireson, Davies 2004).

The effects of ability grouping on students' academic, social and personal outcomes have been studied intensively. Usually it is found that, in respect of academic performance, ability grouping is beneficial for high-ability students whereas low-ability students tend to lose (Duru-Bellat, Mingat 1998, Fiedler, Lange 1994, Fuligni, Eccles 1995, Linchevski, Kutscher 1998, Oakes 1995, Shields 1996). In addition, this effect is cumulative (e.g. Cahan, Linchevski 1996). It has to be mentioned, however, that sometimes there are fewer learning opportunities in lower-track classes (Oakes 1995). Indeed, some studies have demonstrated that good teaching can circumvent problems with low groups (Lou, Abrami, Spence 2000; Wilkinson, Townsend 2000). Thus, losses for low-ability students in homogeneous low-ability groups may be related to poorer teaching quality rather than to the grouping *per se*. Anyway, studies are in agreement that ability grouping is beneficial for high-ability students.

As to the effects on self-esteem, academic self-concept, and test anxiety, the studies have revealed controversial results. These outcomes are more dependent on contextual factors. Some studies have shown positive effects on high-ability students' self-esteem (Byrne 1988), others negative (Wong, Watkins 2001), still others no effect (Marsh, Chessor, Craven, Roche 1995). High-ability students tend to have lower self-concepts when placed in streamed classes of students with similar abilities, compared to ungrouped comparison groups (Kulik, Kulik 1992); higher test anxiety has been found in high-ability students who participate is special high-ability programs (Zeidner, Schleyer 1999).

Although the relations between ability grouping and students' psycho-emotional outcomes are not clear-cut, there is sufficient evidence that attending a private or "elite" school is related to better achievement outcomes. The reasons why students perform better in such schools, however, are not clear. In this longitudinal study we explored the possibility that some schools' better outcomes may result from ability grouping rather than from high quality of the school.

2. Method

2.1. Participants

One hundred and forty seven 7-year-old children participated in the study. There were children from five schools. The number of boys and girls was about equal in all schools. Two schools were usual mainstream town schools (Town 1 and Town 2; 38 and 25 participants, respectively); one was a usual rural school (Rural, 19 participants). These schools mainly served children from the neighbourhood and did not have any entrance tests. The teaching methods were mainly teacher-centred, although group work was also used. There was no ability grouping in the mainstream schools.

One school participated in the Step-by-Step program (Step by Step, 41 participants). The Step-by-Step model stressed the individualised, developmentally appropriate teaching, child-centred practices, but also family participation (e.g. Coleman 1997). Special courses, introducing the ideology and teaching methods, had been given to teachers. Pupils were selected by interviews with families. One of the prerequisites of participating in the Step-by-Step program was just the involvement of parents in school activities.

One school was an “elite” private school (Elite, 24 participants). The curriculum in the school was as in usual mainstream schools, also, the teaching methods were mainly traditional. Some additional lessons were given (English, singing, dancing). The class size was smaller than in mainstream Estonian schools. Differently from other schools participating in the study, this school was technologically well equipped. Pupils were selected on the basis of ability tests.

2.2. Procedure

All children were studied twice. First, at the beginning of he first grade all participants were presented individually with a battery of tests measuring cognitive abilities unrelated to school subjects. Second, two years later, at the beginning of the third grade all participants were presented with a test that measured children’s academic achievement in Estonian language and mathematics. Academic achievement was studied in groups.

2.3. Materials

Battery of Cognitive Tests. Battery of cognitive tests comprised tests for memory, perception, visual-spatial abilities and verbal abilities. Tests were presented individually and in a pseudorandom order. Ten different orders of tests were created randomly and assigned to participants consecutively in order of testing the participants.

Verbal Memory for Words was tested with a verbal free recall task. Two lists of 16 relatively unrelated words were read to children. The number of correctly recalled words was recorded.

Verbal Memory for Sentences (This test was constructed by Marika Padrik and Karl Karlep, University of Tartu) was tested with two sets of sentences. Each set comprised 11 sentences. The first sentence was two words long; one word was added to every subsequent sentence so that the longest sentence was 12 words long. Sentences were presented in the same order from the shortest to the longest. Sentences were read to children. The number of words in the longest sentence recalled correctly was recorded. The results of performance on two sets of sentences were summed.

Nonverbal Memory for Objects was tested with two sets of geometric shapes. Geometric shapes were created in two steps. First a set of 40 shapes was created. After that ten psychology undergraduate students were asked to name the shapes. 20 shapes that were the hardest to name were chosen. In the memory task 4 shapes were presented to children. The number of correctly recognised shapes from 10 was recorded. The results of performance on two sets of shapes were summed.

Nonverbal Memory for Spatial Relations was measured with a test where children were presented with a display of 4 cylindrical (2 x 0.5 cm) pegs placed on a 20 x 20 cm piece of white paper in predetermined positions. Children were required to remember the positions of pegs. Pegs were removed from the paper and a child was asked to put them back in exactly the same places. The number of correctly placed pegs in two presentations was recorded. The placement was scored correct when the centre of a peg placed by a child was in an area covered by a peg presented by the experimenter.

Visual perceptual abilities were measured by a modified version of Poppelreuter's test. Children were presented two pictures of overlapping contours of five objects (Luria 1969, Fig. 119, b and c). The task was made as non-verbal as possible. Thus, instead of asking to name the objects, a forced-choice "non-verbal" procedure was designed. Children were presented ten line drawings of single objects for each of the overlapping pictures and were required to say whether the single object can be found on the Poppelreuter's picture or not. The number of correct answers was recorded.

In another test for measuring visual perceptual abilities a child was presented with a *Contour Picture* of a house in a garden. A child was asked to identify 6 objects embedded in the complex picture. The number of correctly identified objects was recorded.

Visual-Spatial Abilities were measured with two mental rotation tasks. *Parallelogram test* and *Hands test* were presented to children (Luria 1969: 371). In the Parallelogram test, an empty parallelogram was presented to children together with a rotated parallelogram with a small circle in one corner. A child was asked to indicate where in the empty parallelogram the circle should be drawn to get identical images. The number of correct answers in five trials was recorded. In the Hands test, six line drawings of hands (3 left and 3 right) were presented. A child was asked to indicate or say which of the hands, left or right, is represented on a picture. We did not require children to give verbal answers. It was sufficient to raise the hand that corresponded to that on the picture. The number of correct answers was recorded.

For subsequent analyses *Visual-Spatial Abilities* score was computed as a sum of Parallelogram and Hands test results.

There were three tests for measuring verbal abilities. In *Picture Naming* task a set of 25 photos of common objects were presented to children. The number of correctly named pictures was recorded.

Sentence Understanding (This test was constructed by Marika Padrik and Karl Karlep, University of Tartu) was measured with a test where children were required in the forced-choice paradigm to indicate a picture matching the presented sentence. Sentences were created where different relations between objects were expressed. Some relations were usual and some unusual ("A dog is chasing a cat" and "A cat is chasing a dog", for example). In each forced-choice situation there were 4 pictures with the same objects in different relations. Eight sentences were presented. The number of correctly identified pictures was recorded.

Verbal Reasoning was measured with six syllogisms. All syllogisms required a "yes" or "no" answer. (A rabbit and a mouse are friends and eat always together. A rabbit is eating now. Is a mouse eating now?). The number of correct answers was recorded.

Academic Achievement Test. Academic achievement test was created on the basis of national curriculum. The *Language* subtest comprised of three parts: text comprehension, spelling and concepts. Text comprehension was assessed by 7 questions about a short text presented to children. Spelling was assessed by two tasks: writing the text by dictation (the number of mistakes was recorded) and correcting the mistakes in the written text (the text included 7 mistakes). The understanding of concepts "sentence" and "word" was also assessed. The number of correct answers was recorded. The *Arithmetic* subtest comprised 13 arithmetic problems. The number of correct answers was recorded.

3. Results

3.1. Data transformation

All test results were standardized for allowing to summarize test scores. Thus, in the following analyses there are 10 standardized subtest scores from the Battery of Cognitive Tests. A summary Cognitive Abilities Score was also created by summing all standardized subtests. The summary score itself was also standardized. Academic Achievement score was created by summing standardized Reading and Arithmetic subtest scores. The summary score was then standardized.

"School" variable was dummy coded into five new variables, one for every school. In every new dummy coded variable a particular school was coded as 1 and all other schools were coded as 0. We did not omit one school from a dummy coded variables list as it is usually done. That would create a fatal problem for usual Multiple Regression analysis if all 5 dummy coded school variables were entered as independent variables in the analysis. Instead we used a forward-stepwise approach in the following analyses. In this way we could estimate relative impact of all schools on academic achievement in the single analysis.

Dichotomously coded participants' gender was also entered in the analyses. It has been found that girls generally do better than boys on school achievement tests in mathematics and on different verbal tests (Kimura, 1999). Thus, gender may be a variable related to individual differences in academic performance.

3.2. School Differences in Academic Achievement and Cognitive Abilities

Mean Academic Achievement and Cognitive Abilities levels of different schools were compared with School (5) by Performance (2, Academic Achievement vs. Cognitive Abilities) Analysis of Variance. The data are presented in Figure 1. The analysis revealed statistically significant main effect of School ($F_{(4,\ 142)} = 10.65$; $p < .0001$). The main effect of Performance was nonsignificant ($p > .75$) and the School by Performance interaction was also statistically nonsignificant ($p > .65$).

Next we conducted a *post hoc* analysis for school differences in Academic Achievement and in Cognitive Abilities with a Scheffé test. The analysis revealed that average Academic Achievement was significantly higher in Elite school than in all three usual mainstream schools (Town 1, Town 2, and Rural; $p < .01$, $p < .03$ and $p < .005$, respectively). All other differences were statistically nonsignificant ($p > .15$ in all cases). Average Cognitive Abilities score was statistically significantly higher in Elite school than in all other schools (Town 1, $p < .0001$; Town 2, $p < .001$; Rural, $p < .001$; Step by Step, $p < .006$), whereas all other differences between schools were statistically nonsignificant ($p > .5$ in all cases).

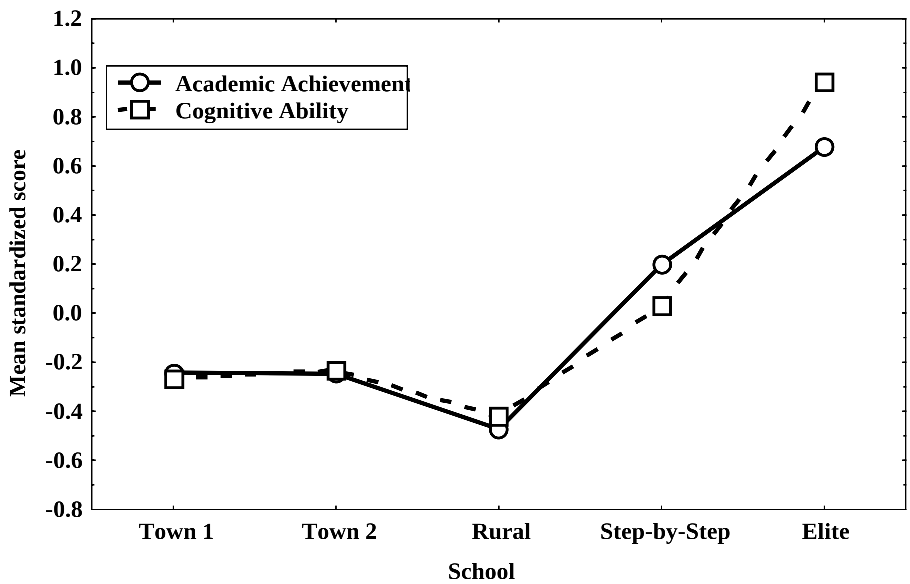

Figure 1. Mean standardized Academic Achievement and Cognitive Ability levels in different schools.

It can be concluded that Elite school children, indeed, outperform children in usual mainstream schools in Academic Achievement. The nonsignificant interaction between School and Performance (Academic Achievement vs. Cognitive Abilities), however, suggests that School differences in Academic Achievement and Cognitive Abilities are almost identical. The Academic Achievement level may characterize differences both in School quality and/or in children's individual abilities. The Cognitive Abilities Score, however, is practically unrelated to the quality of school and characterizes only children's individual differences.

3.3 Academic achievement

We were interested in factors that affect individual differences in Academic Achievement. We conducted a forward-stepwise Multiple Regression analysis where Academic Achievement was a dependent variable. Independent variables were results of the Battery of Cognitive subtests, gender, and dummy coded school (5 variables). The model explained 26% of variance in Academic Achievement ($MR^2 = .26$; $F_{(5,\ 141)} = 10.07$, $p < .0001$). Detailed results of the analysis are given in Table 1.

Inspection of data in Table 1 reveals that higher Academic Achievement was significantly related to attending Elite or Step-by-Step school, Verbal Memory for Sentences, Verbal Memory for Words, and Understanding of Sentences. These

Table 1. Results of forward-stepwise multiple regression analysis. Prediction of academic achievement by gender, subtests of the battery of cognitive tests and school.

Independent variable	Semipartial Correlation	BETA	t(141)	p-level
Statistically significant variables in the model				
Elite School	.244	.267	3.38	< .001
Step-by-Step School	.241	.259	3.33	< .002
Verbal Memory for Words	.196	.210	2.71	< .008
Verbal Memory for Sentences	.166	.177	2.29	< .025
Understanding of Sentences	.157	.167	2.17	< .032
Statistically nonsignificant variables in the model				
Rural School	–.107	–.116	–1.49	= .14
Gender	.083	.087	1.16	= .25
Verbal Reasoning	.077	.081	1.06	= .29
Visual-Spatial Abilities	.073	.075	1.01	= .31
Town 1 School	.068	.080	.94	= .35
Picture Naming	.058	.060	.80	= .42
Contour Picture	.053	.061	.73	= .47
Visual-Perceptual Abilities	–.052	–.053	–.72	= .47
Nonverbal Memory for Objects	–.039	–.040	–.53	= .59
Town 2 School	.023	.025	.32	= .75
Nonverbal Memory for Spatial Relations	.005	.005	.06	= .95

results can be expected: Academic Achievement is mainly related to children's verbal abilities because most of the knowledge acquired in school is verbally mediated, and children from private school or school that is involved in a specific project for improving teaching quality outperform children from usual mainstream schools.

These results, however, can be misleading. Analysis of school differences in Academic Achievement and Cognitive Abilities revealed that differences between schools in Academic Achievement and differences between schools in Cognitive Abilities are almost identical. It might be possible that school differences result from ability grouping rather than from differences in school quality. We therefore conducted another Multiple Regression analysis where we added a new variable to the list of independent variables, an Average School Cognitive Ability level. The new variable is an average score of a school a participant is attending. It should be mentioned that in Town 1, Town 2, and Step-by-Step schools the studied children were from two separate classes. The average cognitive ability levels of two classes of the same school did not differ significantly ($p > .05$ in all three cases). So, data of the classes from the same schools were pooled.

The model explained 27% of variance in Academic Achievement ($MR^2 = .27$; $F_{(5, 141)} = 10.61$, $p < .0001$). Detailed results of the analysis are given in Table 2.

Table 2. Results of forward-stepwise multiple regression analysis. Prediction of academic achievement by gender, subtests of the battery of cognitive tests, school, and average school cognitive ability level.

Independent variable	Semipartial Correlation	BETA	t(141)	p-level
Statistically significant variables in the model				
Average School Cognitive Ability level	.293	.791	3.64	< .0004
Verbal Memory for Words	.187	.199	2.61	< .01
Verbal Memory for Sentences	.181	.194	2.53	< .02
Elite School	–.181	–.549	–2.52	< .02
Understanding of Sentences	.162	.172	2.25	< .03
Statistically nonsignificant variables in the model				
Gender	.084	.081	1.13	= .26
Visual-Perceptual Abilities	–.065	–.064	–.89	= .38
Contour Picture	.048	.042	.58	= .56
Visual-Spatial Abilities	.068	.066	.92	= .36
Nonverbal Memory for Spatial Relations	–.045	–.044	–.62	= .54
Nonverbal Memory for Objects	–.006	–.006	–.08	= .94
Verbal Reasoning	.084	.079	1.11	= .27
Picture Naming	.046	.044	.61	= .54
Town 1 School	.041	.037	.51	= .61
Town 2 School	–.025	–.024	–.33	= .74
Rural School	–.023	–.018	–.24	= .81
Step-by-Step School	–.028	–.009	–.13	= .90

Inspection of data in Table 2 reveals that higher Academic Achievement was significantly related to Average Class Cognitive Ability level, Verbal Memory for Sentences, Verbal Memory for Words, and Understanding of Sentences. The impact of Elite school, however, turned out to be significant and negative! It can thus be suggested that Academic Achievement was higher in the Elite school than in other schools only because of ability grouping.

4. Discussion

In this paper we have shown that attending an elite private school is related to higher academic performance of children. Such result can be interpreted as indicating the high quality of teaching and a better environment for learning in the elite school. We hypothesised, however, that school quality might be confounded with ability grouping. This Elite school selects students on the basis of ability both directly and indirectly, through highly educated parents who, on the one hand have higher income and, on the other, have children with higher abilities. It turned out that when both school and average cognitive ability of a school a child is attending are entered into the Multiple Regression analysis for predicting Academic Achievement, attending Elite school has a *negative* impact on Achievement.

School quality or school effectiveness can be defined in different ways. One way is to assume that high quality of a school is reflected in the high level of academic performance of pupils of the school. The goal of a school, however, is to support the achievement of pupils. Thus, the other way to define the quality of a school is to assume that the quality of a school is reflected in the development of children, in the increase in pupil's knowledge and skills.

In our study, high level of academic performance of Elite school pupils can theoretically be attributed to outstanding teaching quality of the school and/or to ability grouping, to the fact that Elite school selects pupils with high level of cognitive abilities. Our result that attending Elite school had *negative* impact on Achievement when average cognitive ability of a school a child is attending was entered into the Multiple Regression analysis suggests that high academic performance of pupils in the Elite school should be attributed to ability grouping. Negative impact of attending the Elite school suggests that if pupils with similar level of cognitive ability as in the Elite school were studying in some other school in our study their academic performance could even be better than that observed in the Elite school. That result is in agreement with a study of secondary schools by Kirjavainen and Loikkanen (1998) who also found that private schools, other things equal, are less effective than public schools. Thus, in fact the Elite school in our study was the worst school in school quality because attending Elite school was negatively related to academic performance level after ability grouping effect was taken into account. In this case the higher cost of a private school was not justified. This result is in agreement with the earlier studies showing that it is not so important to investigate into material/technical resources than to educate teachers, develop safe and orderly school climate (Lytton, Pyryt 1998) and use teaching methods that take into account pupils' developmental level and abilities (Hyffman, Speer 2000).

We are far from a conclusion that our results can be extended to all private and/or elite schools. There may exist many elite schools that, indeed, give the best education to children – the education that allows to realise the high developmental potential of selected pupils with outstanding cognitive abilities. But we can safely conclude that success of an elite school may partly or fully result from ability grouping. In such cases the higher cost of education is unjustified. We also suggest that measuring school performance only on the basis of output (academic achievement, better jobs or salaries, higher proportion of students continuing education in best universities) can be very misleading. The best school is the school where the potential of students is maximally realised.

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