How the learning environment affects the children's school performance

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Preface

Our paper was written in corporation with the institute for economy and management at The University of Stavanger. The problem for discussion was constructed as a part of a research on how Norwegian welfare, family and education policy could give children better and more similar opportunities in the education and work situation. We would like to thank the project leader Mari Rege and the project administrator Åse Lea for the opportunity to learn and write a paper concerning such an interesting subject. In addition we will give a great thanks to our supervisor, Ingeborg Solli, for all the help and support during the writing period.

Abstract

In this paper we estimate how the learning environment affects the children's school performance. Our learning environment determinant is the percentage of the child's peers having at least one parent with university education. In our regression we use Norwegian register data of all graduating secondary pupils during the years 2002 to 2007 and their parents.

The results in our main analysis, using the final assessments as the dependent variable, indicate a negative peer effect of being in a good learning environment. This indicates that children's school performance gets poorer when the parents' education level at school increases. We carried out subsample analyses and controlled for school fixed effects in the main analysis to explore what kind of mechanisms causing our negative results. The results from the subsample analyses show that the well-performing pupils are more negatively affected being in a good learning environment, and the subsample reveals that there probably is no selection of well-performing pupils into schools. When controlling for school fixed effects in the main analysis the estimates became close to zero. This indicates no peer effect. The results suggest that the negative effect we found in the main analysis was due to school specifics as for instance the school quality or the teachers' grade setting.

To examine the school specifics more thorough we did an analysis using the examination grades as the dependent variable. The results from this analysis revealed a positive peer effect. This indicates that the teacher's grade setting probably was the reason for our negative estimates in the main analysis. We also controlled for school fixed effects in this analysis and found no peer effect. This indicates that a child's peers at school do not influence the child's own school performance. The learning environment, as we measure it, does not affect the children`s school performance.

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1. Introduction

A trend in Norway is that parents move before their children reaches school age. Children at age zero to four move more often than the regular Norwegian (Forgaard, 2005). The parents probably want to live in areas where the schools have a reputation of being a high quality school, measured by the grades achieved by the pupils. In addition to having high achieving pupils, a high quality school may often have high educated teachers and committed parents. A reason why the parents move to areas where schools have a reputation of being of high quality might be because they want their children to be a part of a good learning environment. They probably hope that a good learning environment will give their children a first-rate starting point regarding their education, and that it will help them achieve high real competence. Since many parents choose to relocate when their children are very young (Forgaard, 2005), we were interested in examining whether or not attending schools with a good learning environment have the desired effect on the children's school grades. In this study we therefore examine how the learning environment affects the children's school performance.

The subject in this study is central to many education policy issues. The existence of peer effect and how it affects the children may be important in regards to ability tracking, school choice and classroom organization. For instance, grouping pupils by ability is a current policy issue in Norway. In the west side of Oslo many of the schools have well-performing pupils and the schools are dominated by non-immigrants. In the other side of the city, the east side, the school performance is poorer and there are more immigrants at these schools. A politician suggested moving some of the immigrant pupils from the east to the higher quality schools in the west (Lundgaard, 2009). The reason for this suggestion is the politician thinks that the non immigrant peers will have a positive effect on the immigrants, and that this will increase an immigrant's performance at school.

There is a lot of existing literature concerning how the learning environment affects the children's school performance. The learning environment is often referred to as the peer effect. The peer effect is the influence of the other pupils at school. Peers can influence academic achievement in different ways. There might be positive spillovers of knowledge, motivation and values, as well as negative influence of disturbing peers (Lazear, 2001). Peer pressure may also affect school performance (Akerlof & Kranton, 2002). Peer pressure may reduce the effort in achieving good school grades, in fear of for instance being labelled as a

"nerd". There is on the other hand also peer pressure that may increase achievement. The main findings in literature show a significant peer effect on pupils' achievement (Coleman, et al., 1966; Sacerdote, 2001; Summers & Wolfe, 1977). The pupils at your school are a part of your learning environment and they will therefore probably affect your school performance.

There are different views regarding how the learning environment affects children's school performance. One literature says that if you go to a school with peers performing relatively better than you, you will perform better yourself (Atkinson, Burgess, Gregg, Propper, & Proud, 2008; Hanushek, Kain, Markman, & Rivkin, 2003). You are in a learning environment with high achieving pupils, and this will have a positive effect on your grades. You will learn from your peers and you will have something to reach for in your performance.

The opposite view says that if you are attending a school with well-performing peers, it will have a negative effect on your own school performance. One part of the developmental psychology says that peers can affect your self-esteem. Your self-esteem may be reduced if the people around you are performing relatively better than you. The effect will also occur for higher achieving pupils. The basis for comparison will be higher and it gets more difficult to assert yourself among your peers. Some of the literature supporting this view is regarding the psychological effect of the relative age (Billari & Pellizzari, 2008; Thompson, Barnsley, & Battle, 2004). When it comes to how self-esteem affects the school performance the main view is that there is a correlation between self-esteem and school performance (Davies & Brember, 1999; Howerton, Enger, & Cobbs, 1994; Wylie, 1979). Whether or not there is a causal relationship between self-esteem and education achievement have on the other hand been critical discussed (Baumeister, Campbell, Krueger, & Vohs, 2003; Rosenberg, Schooler, & Schoenbach, 1989).

A third view is that peer effect might be non-linear. Henderson et al. (1978) concluded with a concave relationship between children's school achievement and peer group effect. The achievement of individual pupils increase with an improvement in the average classroom ability, but the rise in achievement is decreasing with the level of average classroom ability. A fourth view is that there is no peer achievement effects at all (Averch, Carroll, Donaldson, Kiesling, & Pincus, 1974; Hanushek, 1972).

As described above, the literature regarding how the peer effect impacts children's school performance are very diverse. The conflicting results may be due to the difficulty in measuring peer characteristics and separating the peer effects from other variables also affecting the children's school performance (Burke & Sass, 2006). There are numerous ways to approach the difficult estimation problem and in addition the data available is often limited. This may be the cause to the diversity of existing empirical evidence in the literature. The diverse results in the literature make the outcome in this study unpredictable.

In summary, it may be negative for children's school performance to attend schools with a bad learning environment, since there are few high achieving pupils to learn from. In addition, the school grades may be negatively affected if the children go to schools with a very good learning environment, since the self-esteem might be negatively affected. The most favourable may be to attend a school where there is an average level of the learning environment.

To do the study we needed data on the school children and their parents. The data we used is from a register database with annual records for every person in Norway (FD-Trygd). In addition, we had a database with school grades of all graduating secondary pupils in Norway from 2002 to 2007. Each person had an identification number which gave us the unique opportunity to link the two databases together.

There are methodical challenges regarding this study. One of the problems is the omitted variable bias. The problem with omitted variable bias may occur if the regressors we use are correlated with unobserved variables which also affect the children's school performance. Because of the omitted variable bias we may also have selection problems; for instance if some parents choose to move to areas with better schools and higher ability pupils. School selection may be driven by attributes of the school and this may be confused with peer effects (Atkinson, et al., 2008; Hanushek, et al., 2003). In order to reduce the problems caused by omitted variables, we include all available variables that may influence the children's school performance. In addition, school fixed effects and grade level fixed effects are controlled for in the regression.

There are also other weaknesses concerning our analyses. The approximation of the learning environment may be a weak spot. Our approximation of the learning environment is the

peers' parents' education. The problem is that the measure may not capture the true peer effect. It may capture something else which also affect the children's school performance. Another limitation is that we use the parental education for each grade level and not for each class. This may be a weakness with our study since the children interact more with the peers in the same class rather than all the children at the same grade level at school.

Our empirical results in the main analysis, where we use the teachers' final assessment as the dependent variable, show a negative peer effect. This indicates that children's school performance gets poorer when the parents' education level at school increases. We carried out subsample analyses, controlled for school fixed effects in the main analysis and used examination grades as the dependent variable to explore what kind of mechanisms causing our negative results. The results from the subsample analyses show that well-performing pupils are more negatively affected than the other pupils, and the results also give us reasons to think there is no selection of well-performing pupils into schools. When controlling for school fixed effects, the relationship between the learning environment and the school achievement became close to zero. This indicates no peer effect. The results suggest that the negative effect we found in the main analysis was due to school specifics, as for instance the school quality or the teachers' grade setting.

The analysis using the examination grades as the dependent variable and not controlling for school fixed effects reveals a positive peer effect. Being in a good learning environment has a positive effect on the child's school performance. The results indicate that the teacher's grade setting probably was the reason for our negative estimates in the main analysis. We also controlled for school fixed effects in the analysis using the examination grades as the dependent variable. The results revealed no peer effect. This indicates that the child's peers at school do not influence the child's own school performance. The learning environment, as we measure it, does not affect the children's school performance.

For the remainder of the paper we will first discuss the existing literature concerning the subject. Second we present our empirical strategy and define the measure of the learning environment. Third the dataset is described, and fourth the empirical results are presented. There will then be a section discussing more generally some variables affecting the children's school performance. At the end of the paper we sum up the study with a conclusion.

2. Existing literature

The existing literature concerning peer effects and how the learning environment affects the children's school performance is wide. The main findings in the literature show there is a significant peer effect on pupil's achievement (Coleman, et al., 1966; Sacerdote, 2001; Summers & Wolfe, 1977). The pupils at your school are a part of your learning environment and they will therefore most likely affect your school performance.

Many studies find a positive effect of being among high ability peers. Hanushek et al.(2003) find that pupils appear to benefit from high achieving peers. As a measure of the pupil achievement they used the mathematic results from a yearly test of academic skills in Texas. To find the measure of the peers they used the peer test scores from two years earlier, but for the current classmates. Other scientists who also concluded there is a positive effect being among more able peers are Atkinson et al. (2008). They based their study on the results of grades in the subjects English and mathematics at schools in England. To measure the ability of each pupil they used a test score, while they used examination scores two years later to find the classroom peer effect.

The two studies mentioned above utilized the academic achievement of the pupils when measuring the peer group characteristics. Another often used measure of the peer group is the parental education in a specific school or classroom. McEwan's (2003) results reveal a positive effect of being in the presence of high achieving peer groups using the parental education in classrooms. He finds that high parental education in the classroom has a positive effect on education, but it is stronger in the case of the mothers' average education. The study was performed on pupils in Chile.

Another view regarding the peer effect is that attending a school with high achieving peers will have a negative effect on your own school performance. One part of the developmental psychology says that the peers can affect your self-esteem. Your self-esteem may be reduced if the people around you are performing better than you. If you are among good peers your performance will be compared with them and your self-esteem might be negatively affected. For instance, if you are performing poorer than most of your peers you might lose your spirit and this might reduce your self-esteem. The effect can also occur for the higher ability pupils. The basis for comparison will be higher and it gets more difficult to assert yourself among

your peers. On the other hand your self-esteem might be positive affected if you are among poorer peers since it is easier to assert yourself among the low achieving peers.

Some of the literature supporting this view is regarding the psychological effect of the relative age. Thompson et al. (2004) studied the relative age effect and the development of self-esteem on pupils in Canada. They find a causal relationship between competition with others older than you, and self-assessment and emotional response. Their results show a linear increase in self-esteem as age at school entry increase. The relatively youngest children are less mature and have lower self-esteem. Another relevant study is from Italy and the results reveal that relative age affects the psychological development (Billari & Pellizzari, 2008). They find that the youngest in a cohort develop social skills as self-esteem at a slower pace than the older children. In addition this study finds that the younger children are less social active and devote more time to studying. The literature mentioned above show that your self-esteem is affected by your peers, and being around higher achieving peers might reduce your self-esteem.

When it comes to how the self-esteem affects the school performance the main view is that there is a correlation between the self-esteem and the school performance. Wylie (1979) found that the correlation between self-esteem and pupil's grades were about 0.30. Hansford and Hattie (1982) explored self-esteem and a variety of performance measures in a total of 128 studies involving 200 000 participants. They concluded with a positive correlation between self-esteem and academic performance. The self-esteem was the cause of between four and seven percent of the variation in the academic performance. Similar results have also been found by Davies and Brember (1999) and Howerton, Enger and Cobbs (1994).

The correlation findings in the studies mentioned above do not indicate weather self-esteem is a cause or a result of academic achievement. Some authors have found that high school achievements lead to high self-esteem (Rosenberg, et al., 1989). The self-esteem is a result not a cause of doing well in school. Bachman and O'Malley (1977) found a correlation between self-esteem and school performance, but they did not find a causal relationship. They concluded that the correlation was likely to be caused by a third variable, such as family background and ability.

Maruyama et al. (1981) focused on younger children between the age of four and fifteen, and found similar results; self-esteem and academic achievement were correlated, but there were no causal relationship. Baumeister et al. (2003) did a study were they used earlier published articles concerning self-esteem. They concluded that the results in earlier studies did not support the view that self-esteem has a causal effect on school performance.

The literature about the self-esteem and the children's school performance concludes that there is a correlation between the variables. But when it comes to finding a causal relationship the empirical results are diverse. Taken this into consideration it is possible that the self-esteem affects the academic achievement, and lower self-esteem may lead to poorer school performance.

A third view regarding the peer effect is that the peer effect might be non-linear. Henderson et al. (1978) concluded with a concave relationship between the children's school achievements and the peer group. The research was based on the results revealed in an earlier study on peer group in Canada. The peer group was measured by the mean of IQ in the classroom. The peer group effect came out to be non-linear. The achievement of individual pupils increase with an improvement in the average classroom ability, but the rise in achievement is decreasing with the level of average classroom ability. The results turned out to be non-linear and this implies that a mixing of pupils with different ability into classes will be optimal. The loss to the strong pupils may be smaller than the gain to the weak pupils.

The fourth view is that there are no peer achievement effects. Hanushek's research (1972) was based on classroom peer effects, and he found no systematic peer group effect. The same results were found by Averch et al. (1974). Their study was based on a review of educational achievement functions. Averch et al. (1974) concluded that there was little evidence for pupil's peers to have a strong influence on the educational outcomes.

To summarize, the literature regarding how peer effect impacts children's school performance are very diverse. Some studies find it is positive being among high ability peers and some suggest the peer effect is non-linear, while others conclude with no peer effect. This literature, in addition to the mechanisms concerning the self-esteem, makes the outcome of our study very unpredictable.

The literature regarding peer effects also often study how peer effect affects pupils with different ability. How the child's peers affect the child's school achievement may differ according to how high achieving the child is compared to its peers. Many find that low ability pupils are more positively affected by high achieving peers than high ability pupils. Summers and Wolfe (1977) found, by using data from Philadelphia School District from 1970-71, that low and middle achieving pupils are clearly helped by being in a school with more high achieving pupils. The well-performing pupils are on the other hand not particularly affected. They also discovered that being in a learning environment where most of the pupils are low achievers is negative for all the pupils' performances, independent of their ability.

Hanushek et al. (2003) support that the lower ability pupils benefit more by high peer achievement than higher ability pupils. In contrast to the findings above a study from a secondary school in England finds that the high and middle ability pupils benefit more than low ability pupils by an improvement in peer achievement (Gibbons & Telhaj, 2006). Another study finds another result; pupils in the middle of the ability distribution benefit from better peers, while pupils with low and high ability do not (Carman & Zhang, 2009). In contrast to the mention studies, Henderson et al. (1978) found no differences regarding how the peer effect affects strong and weak pupils.

3. Empirical strategy

One challenge when it comes to this study is to find an appropriate measure of the learning environment that gives a true picture of the peer effect. Many choose to use either the academic achievement of the pupils (Atkinson, et al., 2008; Hanushek, et al., 2003) or the parental education (McEwan, 2003) in a specific school or classroom.

When the academic achievement of the pupils is being used as a measure of the learning environment, it is important not to let the endogen variable[1] be a part of this measure. Hanushek et al. (2003) and Atkinson et al. (2008) try to avoid this problem by predicting the children's test scores using peers' test scores from two grades earlier or two grades later as the measure of the learning environment. The problem by for example measuring the peers test scores two years earlier is that these test scores may already be affected by the child's peers. Using lagged test scores as an explanatory variable will most likely bias the estimates (Arcidiacono, Foster, Goodpaster, & Kinsler, 2004). Using test scores as a measure of the learning environment is not preferable (Arcidiacono, et al., 2004).

If the peers' test scores is being used as a measure of the learning environment it is preferable to use test scores from before the children begin at school. In this way the measure of the peers' ability is not already affected by the peers. Since we do not have a measure of the peers' ability before they begin at school, we cannot use the children's ability as a measure of the learning environment. Instead we choose to use the parental education as an approximation of the learning environment. Using the parents' education as a measure of the learning environment has also been done by McEwan (2003).

The approximation of the learning environment has both strengths and weaknesses. The strength, and the reason why we can use parental education as an approximation, is that it is positively correlated with the learning environment. If the parental education at a school is high, this will be equivalent with the learning environment being good. There are several reasons for this. Well-educated parents are resourceful and they are often more involved in

[1] An endogenous variable is a variable that is correlated with the error term (Stock & Watson, 2007). In our study the endogenous variable is the weighted average of the child's final assessments in 10th grade. This is the variable giving information about the child's school performance.

their children's education (Stevenson & Baker, 1987). They involve themselves in their children's school environments (Steinberg, Lamborn, Dornbusch, & Darling, 1992; Useem, 1992). They also make high demands to the schools and participate active on the parental meetings. High educated parents are also assumed to create environments that facilitate learning (Teachman, 1987). In addition parents with high education are known to have children performing well at school (Haveman & Wolfe, 1995; Hægeland, Kirkebøen, Raaum, & Salvanes, 2004; Livaditis, et al., 2003). All this contributes to raising the quality of the school and thereby making a good learning environment. The opposite will occur if the average parental education at school is low. The parents are of low socioeconomic status and are assumed to not be so involved in their children's education. The learning environment at these schools will therefore be poorer.

As a measure of the learning environment we use the percentage of the child's peers having at least one parent with university education. The child's peers are the pupils at the same grade level at the same school. We define university education as minimum one year at university. In other words, it is not necessary to have completed a degree to be included in the university education group. This might be a weakness as the socioeconomic difference is probably higher between parents having a university degree and parents not having a university degree, compared to the difference between the parents having minimum one year of university education and parents without any university education. Unfortunately, due to the grouping of education in the databases, we are not able to group the parents according to completed university degree or not. We measure the parental education at the end of the calendar year when the children are nine years old. This is equivalent with third grade before the school reform of 97[2], and fourth grade after the school reform of 97.

A weakness concerning the approximation of the learning environment is that it may not capture the true peer effect. It may capture something else which also affect the children's school performance. Another limitation is that we, due to data limitations, use the parental education to the peers at each grade level and not for each class. Earlier studies have studied both peer interactions at the classroom level (Burke & Sass, 2006; Cooley, 2009) and at the grade level (Hanushek, et al., 2003; McEwan, 2003). Pupils tend to interact more with the

[2] The school reform of 97 is a reform for the primary and secondary school in Norway. This reform increased the year of schooling from nine to ten years. With this reform the children begin at school one year earlier, at the age of six (Kirke-, 1996).

peers in the same classroom rather than all the pupils at the same grade level at school. This may result in a larger peer effect in studies using the classroom level (Carman & Zhang, 2009). We do not have available information regarding the class compositions, and are therefore unable to assign pupils into classrooms. Due to this, our results of the peer effect may be underestimated.

Instead of using a linear variable to capture the learning environment, we split the variable in four quartiles[3] and make dummies for each of the quartiles. Doing this we will be able to capture a possible non-linear relationship. To make sure that each quartile contains one quart of the sample we modified the classification of the quartiles. By doing this, about 25 percent of the sample is placed in every quartile. After the modification, the dummy connected to quartile 1 takes value one if the child attends a school where the percentage of its peers having at least one parent with university education is between 0 and 27.03 percent. The dummy attached to quartile 2 takes value one if the percentage is in the interval 27.04 - 35.71 percent, the dummy attached to quartile 3 takes value one if the percentage is between 35.72 and 46.00 percent and the dummy connected to quartile 4 takes value one if the percentage is between 46.01 and 100 percent.

To find the answer to our problem we use a linear regression model. The following model will be used throughout the analyses:

$$G_i = \alpha + \beta X_i + \eta W_i + \delta Y_i + u_i$$

i = the notation i refers to child i
G_i = the weighted average of child i's school grades in the 10^{th} grade (grade point average)
X_i = dummy variables taking value one for the quartile the child i belongs to
W_i = vector of characteristics of child i and characteristics of child i's father and mother
Y_i = vector of cohort dummies taking value one for the cohort child i belongs to
u_i = error term with mean zero

[3] Quartiles divide the data values into four parts. The first quartile is the 25^{th} percentile, the second quartile is the 50^{th} percentile, the third quartile is the 75th percentile and the fourth quartile is the 100^{th} percentile. (Encyclopaedia Britannica Online: Academic Edition, 2010)

The parameter of interest is β. This parameter tells us how the learning environment at school affects the child's school grades.

As already mentioned there are methodical challenges regarding this study. One of the problems is the omitted variable bias. Omitted variable bias occurs if the regressors are correlated with a variable which has been omitted from the analysis, and that partly determines the dependent variable (Stock & Watson, 2007). The problem with omitted variable bias may occur if for example the parental education to the peers is correlated with unobserved variables which also affect the child's school performance. There are many unobserved variables which affect the children's school performance. Among others, the numbers of hours the parents spend with their child's homework, the eating habits to the child and how many friends the child has are examples of variables we do not have information about. These variables affect the child's school performance and should therefore be included in the regression, but unfortunately we do not have information about them. To minimize the problem with omitted we include all the variables we have information about, for example the child's gender, the child's siblings and the parental income and education.

Due to omitted variables bias we might have a problem with selection. There are several reasons why this problem may occur. The problem may be due to systematic differences in family conditions, school characteristics or teacher differences. The problem can for instance arise if parents choose to move to areas with better schools and higher ability pupils. School selection may be driven by attributes of the school and this may be confused with peer effects (Atkinson, et al., 2008; Hanushek, et al., 2003). For instance if a school is becoming dysfunctional this may contribute to fleeing of all high educated families. The children's performance will decline along with the education of the peers' parents, suggesting that the education of the peers' parents affects the achievement (Hanushek, et al., 2003). However, this is not the case. The well-performing pupils flee and the pupils' performance at school automatic gets poorer. The decrease in performance is due to the school quality and not the parental education at school.

The selection problem may also occur if the allocation of teachers and pupils into classes are not random. This could for instance be the case if the good teachers are assigned to classes with well-performing pupils. The selection problem may also occur if there is selection into schools. In Norway there is no formal demand for entry to the different schools; the pupils are

not assigned to schools according to ability. The school system in Norway will then reduce this problem. On the other hand the children are assigned to schools according to place of residence, and the place of residence is not random. Parents choose their place of residence based on the social set and the people living there. Therefore there may be a selection problem in this study if there are systematic differences between the quality at the schools.

To reduce the biases described above we do the following: first, all available variables affecting the child's school performance are included in our dataset. In addition, school fixed effects and grade level fixed effects are integrated in the regression. The school fixed effects control for characteristics which are unique for the different schools. For instance, this can be the quality of the teachers, the strictness in grade setting or monetary support from the government. The fact that the schools are located in places with different social sets is also controlled for. For instance, systematic differences in the parental education level are controlled for. The grade level fixed effects extract specifics about the pupils in the different school years. The biases are then reduced and the estimates get more accurate.

As mentioned above, we use the final assessments (GPA) as a measure of the pupil's school performance in our main analysis. By using the final assessments it is possible to create an average based on grades in several subjects. However, there are also weak spots with the GPA. The grades may be less objective since it is the teacher that sets the grades. The final assessment may therefore be affected by for instance which teacher you have, your personal appearance and who your peers are. In addition, the school performance measured by GPA is only an approximation of the pupil's real competence, which we are interesting in examine in this study, and this may cause bias. 8. We define the real competence as the competence the children actually have received during the learning period at school. It may be that the grades in the 10^{th} grade do not reflect exactly what the children have learned. An alternative to the final assessments as a measure of the school performance is the examination grades. The results with the examination grades will have more variation since there are fewer examination grades. But the grades are more objective since the grade setting is followed by national standards. These grades may therefore be more adequate to measure the pupil's real competence. In the light of this we also do an analysis where the written examination grades are the dependent variable. The results from this analyse, when controlling for school fixed effects, may capture the true peer effect.

4. Dataset description

In this study we examine the effect of children's learning environment on their school performance. As a measure of the learning environment we choose to use the parental education at school. We use the percentage of the child's peers having at least one parent with university education.

To find a more correct estimate of the effect of the learning environment, we also control for variables concerning the child and the child's family in the regression. Many earlier studies conclude that family background is important for children's school performance (Coleman, et al., 1966; A. T. Henderson & Berla, 1994; Hill & Duncan, 1987; Rumberger, 1995). An early and important contributor to this assertion is Coleman et al. (1966). They concluded that school inputs had very little impact on pupils' performance, while family background and the peer effect had dominating effects. The main lesson from this study was 'It's all in the family'.

In our study we extracted our dataset from two databases provided by Statistics Norway. The first database is called "FD-trygd". This database contains many different variables attached to each person in Norway in the years 1992-2003. There are individual demographic variables (gender, birth date, number of siblings, marital status, immigration status) and socioeconomic variables (education, income, public transfers, wealth, employment status). The second database is an educational database consisting of school identifiers and the school grades of all graduating secondary pupils in Norway from 2002 to 2007. Children born in the years 1986 to 1991 will normally graduate from secondary school in the years 2002 to 2007. This means that we have information regarding the school grades of six different grade levels. Every person in the two different databases has an individual registration number, which gives us the opportunity to link the two databases with each other.

Our variables from the database "FD-trygd" are measured at calendar year end, while the school grades are from the end of the school year, which in Norway is June. When we refer to x^{th} grade we mean the year that the child begins in this grade level.

The variables giving information about the child are birth month, birth year, gender, if the child lives with its parents and if the child is an immigrant. Variables concerning the child's

siblings are number of older and younger siblings, and whether or not the child has siblings born the same year as himself/herself (for example twins, tripling etc.). Variables regarding the child's parents are education, income, wealth, public transfers, employment status, marital status and the age when the child was born. There are also a characteristic which only concern the mother and that is the age difference between the child and the oldest sibling. This variable reveals if the mother has been a teenage mum.

When constructing our dataset we first made a raw data set. In the raw data set we excluded persons with invalid registration number, children and parents who were not situated in Norway (died, disappeared or moved out of the country) and children who did not have a school identifier variable. In addition we only kept the children being born between 1986 and 1991 since we only have the school performance to these children. Our final raw data set consisted of 327 059 children.

As mentioned we use the parental education at school as a measure of the learning environment. More precise we use the percentage of the child's peers having at least one parent with university education. We define university education as at least one year of education at the university. The child's peers are the pupils at the same grade level at the same school. Having different measures for the different grade levels at school gives us a more accurate measure of the learning environment. It is more relevant how the parents' education is for pupils in your own year than for all the pupils at your school. Measuring the percentage of parent's education for each of the six different cohorts will also make the percentage of parent's education vary over time. To avoid bias we exclude the education of the children's own parents in the measure. Including these variables may cause problems and especially at small schools. At small schools the education of the children's own parents affects in a large degree the parental education at each grade level at school.

In order to be able to capture a possible non-linear relationship we split the learning environment variable in four quartiles and make dummies for each of the quartiles. The dummy connected to quartile 1 takes value one if the child attends a school where the percentage of its peers having at least one parent with university education is between 0 and 27.03 percent. The dummy attached to quartile 2 takes value one if the percentage is in the interval 27.04 - 35.71 percent, the dummy attached to quartile 3 takes value one if the

percentage is between 35.72 and 46.00 percent and the dummy connected to quartile 4 takes value one if the percentage is between 46.01 and 100 percent.

The variables concerning number of older and younger siblings, if the child has siblings born the same year as himself/herself, if the parents are divorced or unemployed and the parents' education were observed when the children were nine years old. Before the school reform of 97 this is equivalent with beginning in the third grade, and after the school reform of 97 the children begin in the fourth grade at this age. We bonded each variable to the respective children when they were at the same age.

When we considered the number of siblings we only looked at the number of children being born by the same mother. The reason being children most often live with their mother if born out of wedlock or if the parents get divorced. Your father's children from other relationships will most likely not live in the same household as yourself. Therefore these children will not affect you as much as half brothers and half sisters being born by your mother.

To examine the parents' employment status we used a variable that shows whether they are in search for work or not. We defined the mother and father as unemployed if they were searching for a job and simultaneously were completely unemployed, partial unemployed or on a regular initiative. This means that people without a job who were not in search for a job, will not fall under the category unemployed. The same goes for people in full-time job searching for a new job. The unemployment variable can tell us something about the socio-economic situation to the family. In addition it may affect the family negatively if one of the parents does not get a job.

The variable divorced is also included in the regression. The persons who are registered living in the same house and in addition either are married, registered partners and cohabitants are not defined as divorced. We defined the parents who do not fulfil the criteria above as divorced. This variable will therefore include all the parents who do not live together, independent of a marital status.

Variables that also may have an effect on the children's grades are parental wealth, income and public transfers. As a measure of the parental wealth we used the net wealth because this variable shows the wealth subtracted the debt. In Norway many put their wealth in housing

and this result in this variable being less explanatory. When it comes to the parental income we used the employment income as a measure of this variable. We also included the variable public transfers, which among other things consists of social security benefit, unemployment benefit and child support payments.

The variables concerning parental income, public transfers and wealth are measured as an average of six years, starting when the children are six years old. By doing this we smooth the random variation for a given year. Some of the parents had missing values when it came to one or more of these three variables. To avoid that the average of these variables would be missing we converted the missing values to zero.

We included squared terms for wealth, income and public transfers, to catch up whether the effect of these variables were increasing or decreasing. The other continuous variables in the dataset also got included as squared terms to make the model more flexible.

According to the Statistics Norway we defined an immigrant as a person with both parents being born abroad (Akselsen, Lien, & Sivertstøl, 2007). In the case of immigrants there is a flaw with the registration of the education. For people who immigrated to Norway in 1991 or later, and for 30 to 40 percent of the immigrants coming to Norway between 1980 and 1990, there is no information about achieved education in their homeland (Johansen & Lajord, 2000). As a result of this, many of the children with immigrated parents will have a missing value when it comes to the education level.

The parental education follows the Norwegian standard for education grouping and consists of nine groups of education (Statistics Norway, 2000). To make it more lucid we chose to group the education in fewer groups. The parental education was grouped in four levels; group one contains the parents with only compulsory school; group two consists of the high school graduates; group three consists of four years or less of university education (e.g. basic course or bachelor's degree); and group four consists of more than four years of university education (e.g. master's degree or PhD). Persons who have completed more than one education are registered with the highest level of education (Johansen & Lajord, 2000). People with no schooling and missing values are coded as its own education group.

As described above, the database with the school grades consists of all graduating secondary pupils in Norway from 2002 to 2007. We chose to exclude the pupils who started school one year earlier or later than the majority, for instance the children who were born in 1987 but did not graduate in 2003. There were 4824 individuals (1.47percent) who did not graduate in the "right" year and got excluded from the dataset. The reason why there are few children who began earlier or later at school is the strict enrolment rules in Norway. The school law requires every child born in the same year to begin at school at the same time, and very few children get exempt from this rule. In addition, it is not common to get promoted faster or having to retain a grade.

The children's school performance is the dependent variable in this study. The school performance is measured by the children's school grades. After September 2006 the grade system in Norway is numerical and goes from one to six, where one is failure, two is the lowest passing grade and six is the best grade. Prior to 2006 the grade system went from zero to six, where zero and one are failure. To be able to compare the grade systems we converted all the grades with value zero to value one.

The subjects the pupils are graded in are Norwegian oral and written, Norwegian secondary language, mathematics, English oral and written, social studies, physical education, Christian knowledge and religious and ethical education, science and the environment, music, arts and crafts and home economics. We chose to use the teacher's final assessment in the different subjects. When it comes to Norwegian secondary language 8.80 percent of the children in our dataset missed a grade in this subject. Since there were many children without a grade in this subject we decided to exclude it from our measure of the children's school grades. The reason why many pupils are missing the grade in this subject is because some pupils are exempt from this subject. This is especially the case for immigrants. We only wanted to keep the children with grades in all the remaining subjects, and we therefore dropped 17451 children (5.4 percent) who missed a grade in at least one subject. This is children who did not have enough hours in the class to receive a grade or children who have got an exemption in a subject for some reason.

We used the children's grades to compute an average of all the grades in the different subjects, and will from now on call this the grade point average (GPA). There are different methods of uniting the grades in the different subjects into a summary measure (Hægeland, et

al., 2004). For instance, it may be argued that some subjects are more appropriate to measure the overall competence than others, and that grades in these subjects will be better predictors of future school performance and labour markets outcomes. To weight two different subjects like mathematics and music equally in the average may not be the most proper way. For example, studies have shown that numeric and quantitative skills are more related to future labour market outcomes than other subjects, and therefore mathematics ability are more important in the summary measure (Dougherty, 2000; Paglin & Rufolo, 1990).

We chose to use a summary measure of the grades based on the method constructed by Hægeland et al. (2004). We used a weighted average depending on the number of teaching hours during the secondary school. With this method a small subject as music will not get the same weight as a more comprehensive subject like mathematics. The subjects which have more teaching hours are weighed more in the GPA[4]. As provided in the curriculum from 1997 the numbers of teaching hours in Norwegian secondary language is integrated in Norwegian primary language (Det kongelige kirke-, 1996). It is up to each school and teacher to decide how many hours to use on the curriculum in Norwegian secondary language. Since we chose to exclude the grades in Norwegian secondary language, we wanted to reduce the weight of Norwegian primary language. After contacting some teachers in the subject Norwegian we decided to reduce the number of teaching hours in this subject with one fifth.

[4] The number of teaching hours is from the curriculum for the 10-year compulsory school in Norway valid from the year 1997 (Det kongelige kirke-, 1996). This curriculum was in force until there came a new syllabus in august 2006 ("Kunnskapsløftet"). The first year the new syllabus only affected 1 th – 9th graders, and therefore none of the children in our sample is affected by this syllabus (Kunnskapsdepartementet, 2006).

Table 1: The computation of the GPA

Subject	**Number of teaching hours**[5]	**Grades in the subjects**	**Formula for weights**
Norwegian written and oral (Norsk)	532*4/5	NOR^W and NOR^O	$W\_NOR = (NOR^W + NOR^O)/2 * (532*4/5)$
Mathematics (Matematikk)	418	MAT	W_MAT = MAT * 418.0
English written and oral (Engelsk)	342	ENG^W and ENG^O	$W\_ENG = (ENG^W + ENG^O)/2 * 342.0$
Social studies (Samfunnsfag)	380	SOS	W_SOS = SOS * 380.0
Physical education (Kroppsøvning)	304	PHE	W_PHE = PHE * 304.0
Christian knowledge and religious and ethical education (KRL)	247	CRE	W_CRE = CRE * 247.0
Science and the environment (Natur- og miljøfag)	342	SCE	W_SCE = SCE * 342.0
Music (Musikk)	114	MUS	W_MUS = MUS * 114.0
Arts and crafts (Kunst og håndverk)	228	ART	W_ART = ART * 228.0
Home economics (Heimkunnskap)	114	HOE	W_HOE = HOE * 114.0
Sum	2914.6		W_SUM

Formula for weighted grade point average, W_GPA:

$$(1) \quad W\_GPA = \frac{W\_SUM}{\text{Total number of teaching hours}}$$

There were 188 pupils who were attending a school with no other pupils at his/her age. It does not make sense to study the peer effect in a grade level with no peers. That is the reason why we chose to drop these 188 children (0.06 percent) from the dataset.

5 The number of teaching hours is from the curriculum for the 10-year compulsory school from 1997 (Det kongelige kirke-, 1996), page 81

It may be of importance if the children have moved during the primary or secondary school and thereby switched to a new learning environment. It is optimal for the study that the children go to the same school and are in the same learning environment during the primary and secondary school. However we assume that few families move during this period. It is most common that families move before the children begin at school or early in the primary school (Forgaard, 2005). They will then stay in the same environment for most of the schooling period.

After excluding the pupils mentioned above our final sample consists of 304599 pupils.

In the regression we used the following variables:

The learning environment:

- The percentage of the child's peers having at least one parent with university education. The child's own parents' education is not included.

The child's characteristics:

- Gender
- Number of younger and older siblings (0, 1, 2, 3, 4 or more than 4 siblings)
- Multiple birth
- Siblings being born the same year as yourself without being twin, tripling etc.
- Birth month (12 months)
- Birth year
- Immigration status
- If child lives without any of its parents (for example lives in an orphanage)

The parents' characteristics:

- Income, public transfers and wealth
- Education (divided in level 1, 2, 3 and 4)
- Age at birth of child

- Divorced
- Employment status
- Age difference between the child and its oldest sibling (teenage mum)

Table 2: Sample trimming for final analytic sample

Variable	Dropped from our dataset	Number	Net sample
Raw dataset			327 059
Graduating year	Pupils graduating one year earlier or later than normal	4824	327 059
Graduating subjects	Pupils missing a grade in at least one subject	17451	322 235
Size of grade level at school	Pupils attending a school where there are no other pupils in their grade level	188	304 784
Final analytic sample			304 599

Table 3: Summary statistics

	All	Quartile 1	Quartile 2	Quartile 3	Quartile 4
Dependent variable					
10^{th} grade GPA	4.0245	3.9413	3.9739	4.0128	4.1700
	(0.8281)	(0.8393)	(0.8387)	(0.8304)	(0.7841)
Independent variables					
Child's characteristics					
Female	0.4925	0.4933	0.4932	0.4939	0.4896
	(0.5000)	(0.5000)	(0.5000)	(0.5000)	(0.4999)
Born in January to June	0.5150	0.5181	0.5152	0.5127	0.5140
	(0.4998)	(0.4997)	(0.4998)	(0.4998)	(0.4998)
Born in July to	0.4850	0.4819	0.4848	0.4873	0.4860
December	(0.4998)	(0.4997)	(0.4998)	(0.4998)	(0.4998)
Oldest sibling	0.4429	0.4339	0.4396	0.4455	0.4525
	(.04967)	(0.4956)	(0.4963)	(0.4970)	(0.4977)
Youngest sibling	0.4419	0.4167	0.4379	0.4482	0.4648
	(0.4966)	(0.4930)	(0.4961)	(0.4973)	(0.4988)
Mother's characteristics					
Education: Compulsory	0.4693	0.5764	0.5168	0.4592	0.3248
school	(0.4991)	(0.4941)	(0.4997)	(0.4983)	(0.4683)
Education: High school	0.2367	0.2302	0.2402	0.2473	0.2292

graduate	(0.4251)	(0.4209)	(0.4272)	(0.4315)	(0.4203)
Education: University education	0.2416	0.1590	0.2064	0.2478	0.3533
	(0.4281)	(0.3656)	(0.4047)	(0.4318)	(0.4780)
Education: Master's or doctor's degree	0.0316	0.0111	0.0163	0.0245	0.0742
	(0.1748)	(0.1048)	(0.1267)	(0.1547)	(0.2621)
Income	134508.5	114989.8	125761.9	135980.7	161293.6
	(98865.08)	(82363.95)	(87773.92)	(93644.65)	(121054.5)
Unemployed	0.0417	0.0559	0.0455	0.0398	0.0259
	(0.2000)	(0.2297)	(0.2083)	(0.1954)	(0.1587)
Divorced	0.2205	0.2151	0.2247	0.2296	0.2129
	(0.4146)	(0.4109)	(0.4174)	(0.4206)	(0.4093)
Age (when child was born)	27.8501	27.1845	27.4819	27.8000	28.9332
	(4.9830)	(5.0567)	(4.9776)	(4.9170)	(4.8001)
Father's characteristics					
Education: Compulsory school	0.3810	0.4788	0.4161	0.3697	0.2593
	(0.4856)	(0.4996)	(0.4929)	(0.4827)	(0.4383)
Education: High school graduate	0.3324	0.3443	0.3512	0.3416	0.2925
	(0.4711)	(0.4751)	(0.4774)	(0.4743)	(0.4549)
Education: University education	0.1788	0.1195	0.1556	0.1887	0.2513
	(0.3831)	(0.3244)	(0.3625)	(0.3912)	(0.4337)
Education: Master's or doctor's degree	0.0871	0.0356	0.0566	0.0785	0.1777
	(0.2820)	(0.1853)	(0.2310)	(0.2690)	(0.3823)
Income	287607.9	252005.6	268133.9	284469.7	345771.4
	(195601.8)	(133620.1)	(150825.5)	(159421.3)	(286173.6)
Divorced	0.2205	0.2151	0.2247	0.2296	0.2129
	(0.4146)	(0.4109)	(0.4174)	(0.4206)	(0.4093)
Unemployed	0.0253	0.0302	0.0267	0.0246	0.0199
	(0.1571)	(0.1710)	(0.1611)	(0.1548)	(0.1398)
Age (when child was born)	30.7430	30.2959	30.4312	30.6345	31.6092
	(5.6957)	(5.7850)	(5.6972)	(5.6433)	(5.5618)
N (observations)	304 599	76 350	75 995	75 976	76 278

Notes:
The treatment variable is dummies for the percentage of the child's peers having at least one parent with university education, divided in quartiles, as described in section 3 (empirical strategy).

The dependent variable shows a positive and linear relationship between the quartiles and the GPA. This means that the higher the percentage of the child's peers having parents with university education, the higher the child's GPA will be. This indicates that being in a good learning environment is positive for the child's GPA.

The summary statistics regarding the child's characteristics show that there are fewer girls than boys in our sample, but the sex distribution between the four quartiles is fairly equal. The

distribution of the time of birth in the year is also fairly equal among the four quartiles, but in all four quartiles there are fewer children being born late in the year. There is a pattern in the distribution of being the youngest and/or the oldest sibling. The higher the quartile, the higher is the percentage of children being the oldest or the youngest sibling. A possible explanation might be that there is a positive correlation between the quartile the child belongs to and the child's own parents' education. If this is the case, being in a higher quartile increases the chance of having well-educated parents yourself. High educated parents might not have as many children as lower educated parents, making it more likely to be a single child - meaning that you are both the youngest and oldest sibling in your family.

When it comes to the distribution of the fathers' and the mothers' education we see that the percentage of parents with only compulsory school decreases as we move to a higher quartile, and the percentage of parents with master's or doctor's degree increases as we move to a higher quartile. This is reasonable as the quartiles are divided in groups according to the percentage of the child's peers having at least one parent with university education. This suggests a positive correlation between the quartile the child belongs to and the child's own parents' education.

Both parents' income increases as we move to a higher quartile, meaning that children being in the highest quartiles have parents who earn the most while children in the lowest quartile have parents earning the least. We have already seen that children being in a higher quartile have a higher percentage of well-educated parents. Knowing this, it is not unexpected that children in the highest quartile have parents who earn the most, as there often is assumed to be a positive relationship between education and income.

There is an uneven distribution of unemployed parents between the four different quartiles. The percentage of unemployed mothers and fathers decreases as you move to a higher quartile. Among the children in quartile 4 only 2.6 percent of the mothers and 2.0 percent of the fathers are unemployed. The unemployment rate among the mothers and fathers of children in quartile 1 is 1.2 percentage points and 0.6 percentage point higher respectively.

An uneven distribution is also the case when it comes to the parents' age when the child was born. The higher the quartile the child is in, the higher the parents' age where when the child was born. The difference in the age among the fathers of the children in the 1^{th} and the 4^{th}

quartile is about 0.9 years, while the difference regarding the mothers age when the child was born is about 1 year.

When it comes to having parents who are divorced, meaning not registered as living together, there is no linear relationship between the distribution of divorced parents and the quartiles. Children being in quartile 1 and 4 have a lower percent of divorced parents, while children in quartile 2 and 3 have the highest divorce rate among their parents.

5. Empirical results

5.1 The effect of the learning environment on children's school performance

In Table 4 we present our ordinary least squares estimates for the effect of the learning environment on the children's school performance. Our treatment variable is the learning environment, and as a measure of the learning environment we use the percentage of the child's peers having at least one parent with a university education.

Table 4: Main results: How the learning environment affects the children's GPA

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Dependent variable: GPA						
Quartile 1	Reference value	Reference value	Reference value	Reference value	Reference value	Reference value
Quartile 2	0.0326***	-0.0251***	-0.0247***	-0.0285***	-0.0294***	0.0008
	(0.0042)	(0.0039)	(0.0038)	(0.0037)	(0.0036)	(0.0046)
Quartile 3	0.0715***	-0.0378***	-0.0381***	-0.0454***	-0.0476***	-0.0091*
	(0.0042)	(0.0039)	(0.0038)	(0.0037)	(0.0037)	(0.0055)
Quartile 4	0.2287***	-0.0289***	-0.0289***	-0.0547***	-0.0639***	-0.0022
	(0.0042)	(0.0040)	(0.0039)	(0.0038)	(0.0038)	(0.0072)
Included control variables						
Own parents' education		X	X	X	X	X
Child's characteristics			X	X	X	X
Mother's characteristics				X	X	X
Father's characteristics					X	X
School fixed effects						X
Mean	4.0245	4.0245	4.0245	4.0245	4.0245	4.0245
Standard deviation	0.8281	0.8281	0.8281	0.8281	0.8281	0.8281
R-squared	0.0112	0.1724	0.2193	0.2593	0.2667	0.2892
N (observations)	304 599	304 599	304 599	304 599	304 599	304 599

Notes:
Model 1to 6 are OLS estimates for the effect on the GPA of the learning environment. The standard deviations are in parenthesis. *, ** and *** denote significance at 10 percent, 5 percent and 1 percent level.
The treatment variable is dummies for the percentage of the child's peers having at least one parent with university education, divided in quartiles, as described in section 3 (empirical strategy).

In Model 1 we only include the treatment variables, and do not include any of the control variables. The results indicate that the peer effect of being in a good learning environment is positive. The better the learning environment is, the higher the child's grades are. When we include the child's own parents' education in Model 2 the results show that the learning environment has almost the complete opposite effect on the GPA compared to Model 1. Now it seems like being in a good learning environment is not favourable regarding the child's grades. The change in the results indicates that the positive peer effect we found in Model 1 was due to the omission of the child's own parents' education. The positive effect of having well-educated parents was probably caught up in the treatment variable in Model 1. The significant change we get when including the child's own parents' education indicates that this variable has a great impact on the child's grades.

The negative effect in Model 2 is not linear. Being in a learning environment where less than 27.03 percent of your peers have at least one parent with a university education (quartile 1), is the best regarding your GPA. Being in a learning environment where 27.04-35.71 percent (quartile 2) and 46.01-100 percent (quartile 4) of the peers' parents have university education reduces the school performance some, while the GPA gets most negatively affected by being in a learning environment where 35.72-46.00 percent (quartile 3) of the peers' parents have university education.

In Model 3 we include the child's characteristics (gender, birth month, birth year, information about siblings, immigration status and if the child lives without its parents). The results do not change considerably when including these variables. In model 4 and 5 we also include the mother's and father's characteristics (income, wealth[6], public transfers, unemployment, divorced, age when child was born, age difference between the child and the oldest sibling). The negative effect increases some when controlling for these variables. In addition the relationship between the learning environment and the GPA is now linear. Every increase in

[6] The variable wealth may not capture all the elements included in the parent's wealth. Real estate is the most common element in the wealth. The value of a real estate is usually very high, but the assessed value is only a fraction of the total value. Our measure of wealth only captures the assessed value, and the variable will therefore only capture a fraction of the true value. We tried to exclude the variable wealth, but the results did not change significantly. The results are robust to excluding this variable and we therefore can conclude that parental wealth is not a source of bias.

the learning environment, even going from quartile 3 to quartile 4, will lower the child's grades.

In Model 5 all the control variables are included and the results show that the peer effect of being in a good learning environment is negative and statistically significant. Being in quartile 1 is the best regarding the child's GPA. Being in quartile 2, quartile 3 or quartile 4 will reduce the child's school grades with 0.036σ, 0.057σ, 0.077σ respectively, compared to being in quartile 1. This indicates that being a part of a learning environment where your peers have well-educated parents is not good for your school performance.

The effect is linear; the better the learning environment is the worse it is for the children's GPA. We define the learning environment as the percentage of the child's peers having at least one parent with university education. The results therefore imply that being among peers who have parents with low education is favourable. This indicates that the parents should choose a school for their children with a bad learning environment. By doing this the children's grades will be positively affected, and this will help them getting in to schools after the compulsory school.

An explanation to the negative results may be related to the self-esteem. Being in a learning environment with many high achieving pupils may lower the self-esteem and result in lower school grades. For the high ability pupils it will be more difficult to assert oneself since the basis for comparison will be higher. The low ability pupils may on the other hand lose their spirit since they are performing relatively poorer than their peers. In order to avoid this possible effect, it is favourable to be among low achieving peers.

Another possible explanation of the negative relationship between the learning environment and the school performance could be that there are systematic differences between the school characteristics. One possible school specific explaining the results could be the teachers and their grade setting. The teachers have expectations to the pupils and their school performance. The expectations may be higher among the teachers in schools were the majority are well-performing pupils. This may make it more difficult to get good grades at a school with many well-performing peers. The child's achievement tests will be compared to the tests of well-performing peers. If this is the case it would be preferable to be in a bad learning environment regarding your grades.

A second possible school specific, that might not be as obvious, is the school quality. The schools were the parents have low education may in fact be better than schools were the parents have high education. This could be the case if for example good teachers are attracted to schools were the pupils come from low advantaged families. The teachers might find it more challenging and rewarding to teach in these types of schools, were the teachers role is even more important. It is also possible that schools in less advantaged areas receive more governmental support etc., making these schools better than the schools with pupils who have high educated parents.

We have in section 3 (empirical strategy) mentioned that we might have a selection problem related to parents' choice of residence. Parents with high education are often assumed to be very involved in their children's education and thereby contribute to raising the learning environment at the school. But it could also be the case that parents with high education choose to move to more expensive areas with higher quality schools in order for their children to be a part of a good learning environment. We have a selection problem if parents only *move* to a high quality school, and are not the cause of the high quality. If this were the case in our regression, we would expect the results to show a positive relationship between the child's school performance and the parents' education at school. Since we find a negative relationship, the expected selection problem is not present. However, the negative relationship revealed may be due to a selection problem with opposite sign. The problem is connected to the quality of the schools. The parents may think they are choosing a good school for their children, but in fact the school is of lower quality.

The results we get from the main analysis when not controlling for school fixed effects suggest that the GPA is negatively affected by being in a good learning environment. However, it is important to realize that GPA does not necessarily measure the real competence of the pupils. Being in a good learning environment may still have a positive effect on the real competence.

We carried out some additional analyses to examine further which mechanisms causing our negative relationship in the main analysis. We wanted to test the possible explanations presented above. First we carried out subsample analyses, then we controlled for school fixed

effects and last we did an analysis where the examination grades were the dependent variable. The following sections present the results from these analyses.

5.1.1 Subsample analyses

The results from the main analysis indicate as described above a negative peer effect. The GPA gets negatively affected by being in a good learning environment. We wanted to examine further what kind of mechanisms which caused our results. To explore if the selection of pupils into school were the cause of our negative results we carried out subsample analyses. The results from the subsamples are summarised in Table 5, part 1 and 2.

In the subsample analyses we compared children with different genders, children with parents who have and do not have university education, children with parents who live together and do not live together, children born at different times of year and children who are the youngest and the oldest sibling. The main results from the subsamples are the same as in the main analysis in Table 4, Model 5 - the peer effect of being in a good learning environment is negative. However, it seems like the children who normally perform better at school; girls, children born early in the year, children with high educated parents and children with parents living together, have a stronger negative treatment effect. The assumption that these children normally perform better is confirmed by our analysis were we look generally at the variables affecting the children's school performance. These results are presented in section 6, Table 8. There are also existing empirical results consistent with this assumption (Amato & Keith, 1991; Atkinson, et al., 2008; Crawford, Dearden, & Meghir, 2007; V. Henderson, et al., 1978; Summers & Wolfe, 1977).

We see that the coefficients concerning children, who are assumed to be better at school, are more negative than the coefficients for the children who are not assumed to be so good at school. These results are not consistent with the literature regarding this subject. Several studies conclude that the children's school performance is positively affected by high achieving peers. In addition many studies find that the low-ability pupils are more positively affected by high achieving peers than high-ability pupils (Hanushek, et al., 2003; Summers & Wolfe, 1977). In our case the effect is opposite and it is the high ability pupils who are most affected, but in a negative way.

Table 5, part 1: Subsample analyses – not controlling for school fixed effects

	Model 1	Model 2		Model 3		Model 4		Model 5	
Dependent variable : GPA									
Subsample	Non[7]	Gender		Birth month		Sibling		Father's education	
		(a) Female	(b) Male	(a) January to June	(b) July to December	(a) The youngest sibling	(b) The oldest sibling	(a) Father no university education	(b) Father university education
Quartile 1	Reference value	Reference value	Reference value	Reference value	Reference value	Reference value	Reference value	Reference value	Reference value
Quartile 2	-0.0220*** (0.0037)	-0.0305*** (0.0051)	-0.131** (0.0053)	-0.0236*** (0.0052)	-0.0202*** (0.0053)	-0.0131** (0.0057)	-0.0199*** (0.0056)	-0.0279*** (0.0042)	-0.0164** (0.0079)
Quartile 3	-0.0349*** (0.0037)	-0.0451*** (0.0051)	-0.0239*** (0.0054)	-0.0379*** (0.0052)	-0.0313*** (0.0053)	-0.0307*** (0.0057)	-0.0232*** (0.0056)	-0.0358*** (0.0044)	-0.0508*** (0.0076)
Quartile 4	-0.0428*** (0.0039)	-0.0586*** (0.0054)	-0.0263*** (0.0056)	-0.0499*** (0.0054)	-0.0353*** (0.0055)	-0.0349*** (0.0059)	-0.0207*** (0.0058)	-0.0260*** (0.0048)	-0.0733*** (0.0072)
Mean	4.0245	4.0245	4.0245	4.0245	4.0245	4.0245	4.0245	4.0245	4.0245
Standard deviation	0.8281	0.8281	0.8281	0.8281	0.8281	0.8281	0.8281	0.8281	0.8281
R-squared	0.2484	0.2215	0.2177	0.2417	0.2524	0.2317	0.2522	0.1786	0.1457
N (observations)	304 599	150 011	154 588	156 869	147 730	134 893	134 616	217 294	80 989

[7] The reason why the coefficients in this column will differ from the coefficients in table 4, model 5, is because we divide the child's own parents' education in smaller groups. We do not use the four different education levels we used in table 4. We now only have two levels – university education and no university education.

Table 5, part 2: Subsample analyses – not controlling for school fixed effects

	Model 6		Model 7		Model 8		Model 9	
Dependent variable: GPA								
Subsample	Mother's education		Father's employment		Mother's employment		Parents marital status	
	(a) Mother no university education	(b) Mother university education	(a) Employed	(b) Unemployed	(a) Employed	(b) Unemployed	(a) Living together	(b) Not living together
Quartile 1	Reference value	Reference value	Reference value	Reference value	Reference value	Reference value	Reference value	Reference value
Quartile 2	-0.0224***	-0.0396***	-0.0213***	-0.0487**	-0.0220***	-0.0300*	-0.0260***	-0.0079
	(0.0043)	(0.0076)	(0.0037)	(0.0237)	(0.0038)	(0.0174)	(0.0041)	(0.0083)
Quartile 3	-0.0337***	-0.0690***	-0.0353***	-0.0203	-0.0358***	-0.0223	-0.0414***	-0.0133
	(0.0044)	(0.0073)	(0.0038)	(0.0244)	(0.0038)	(0.0182)	(0.0042)	(0.0083)
Quartile 4	-0.0281***	-0.0873***	-0.0436***	-0.0025	-0.0442***	0.0108	-0.0581***	0.0106
	(0.0048)	(0.0069)	(0.0039)	(0.0264)	(0.0039)	(0.0213)	(0.0043)	(0.0087)
Mean	4.0245	4.0245	4.0245	4.0245	4.0245	4.0245	4.0245	4.0245
Standard deviation	0.8281	0.8281	0.8281	0.8281	0.8281	0.8281	0.8281	0.8281
R-squared	0.1722	0.1464	0.2469	0.1703	0.2474	0.1827	0.2253	0.2075
N (observations)	215 048	83 208	296 883	7 716	291 885	12 714	237 428	67 171

Notes:
Estimates reflect results from OLS models, adjusted for year fixed effects, child characteristics (birth month, gender, immigrant, lives with its parents, older and younger siblings and siblings born the same year) and parents' characteristics (education level, income, wealth, transfers, material status, employment status and age when the child was born). The standard deviations are in parenthesis. *, ** and *** denote significance at 10 percent, 5 percent and 1 percent level.
The treatment variable is dummies for the percentage of the child's peers having at least one parent with university education, divided in quartiles, as described in section 3 (empirical strategy).

Our subsample results suggest that well-performing pupils suffer more from being in a good learning environment than pupils who perform poorer in school. These results may be due to selection of well-performing pupils into schools. The well-performing children's parents might in a higher degree move to schools assumed to be of better quality compared to the parents of children performing poorer at school. The schools assumed to be of better quality may in fact be of lower quality. The well-performing children are therefore more negatively affected by being in a learning environment assumed to be good.

On the other hand the results concerning the gender reveal something interesting; the girls get more negatively affected by a good learning environment than the boys. In average, schools have the same quantity of female pupils and male pupils, and it is unlikely that the girls' parents move more to schools assumed to be of high quality than the boys' parents. There is therefore no reason to believe that there is selection of gender into schools. This being considered it is unlikely that there is selection of well-performing pupils into schools. This implies that the negative relationship in the main analysis is not due to selection of pupils into schools.

5.1.2 School fixed effects

A reason for the negative relationship between the learning environment and the GPA in the main analysis may, as mentioned, be systematic differences in the school characteristics. To examine this hypothesis we controlled for school fixed effects in the main analysis.

In Table 4, Model 6 we present the results from this analysis. When controlling for school fixed effects the results go from showing a negative relationship to showing almost no relationship between the learning environment and the GPA. The peer effect is approximately zero for all four quartiles. There is no longer a negative peer effect. The coefficients concerning the learning environment are however no longer statistically significant. The only significant coefficient is the one in quartile 3. The results indicate that the learning environment, as we measure it, has no impact on the children's school performance.

The disappearance of the negative peer effect when controlling for school fixed effects makes the hypotheses regarding the self-esteem less likely. The estimates do not imply that being in

a good learning environment reduces your self-esteem and your school performance. The results do not support the assumption that the pupils' self-esteem gets negatively affected by being in a good learning environment.

The change in the results after controlling for school fixed effect suggests that the negative peer effect we found was due to the school specifics. When controlling for school fixed effects the systematic differences between the schools are removed and the negative peer effect disappears. These results imply that the negative peer effect we found probably was due to systematic differences between the schools; it may be the teachers' grade setting or the school quality, or both. There are systematic differences between the schools where parents have low education and high education.

The results may be biased by the approximations we use in our analyses. We might use an unsatisfying measure of the learning environment. The education level of the children's parents might not capture the true peer effect. The measure may capture other effects influencing the children's school performance. Our measure of the pupil's real competence may also cause bias. There might be a positive or negative peer effect on real competence which we are not able to capture. The reason is that the measure we use to capture the children's performance, GPA, is measured dissimilar by the different teachers at the different schools. The GPA might therefore not be a correct measure of the pupil's real competence. We will examine this more under section 5.2 (Analysis with the examination grades).

We also controlled for school fixed effects in the subsample analyses described in the previous section. The results from this analysis are presented in Table 6, part 1 and 2. The results in Table 6 are consistent with the results in Table 4, Model 6; the negative effect disappears when controlling for school fixed effects. The estimates become close to zero. The results reveal no differences in the peer effect between the well-performing pupils and the pupils performing poorer in school. It is therefore not the case that the high achieving pupils get more negatively affected by being in a good learning environment. The analysis implies that the school specifics were the reason for the stronger negative effect for the high achieving pupils.

Table 6, part 1: Subsample analyses – controlling for school fixed effects

	Model 1	Model 2		Model 3		Model 4		Model 5	
Dependent variable : GPA									
Subsample	Non[8]	Gender		Birth month		Sibling		Father's education	
		(a) Female	(b) Male	(a) January to June	(b) July to December	(a) The youngest sibling	(b) The oldest sibling	(a) Father no university education	(b) Father university education
Quartile 1	Reference value	Reference value	Reference value	Reference value	Reference value	Reference value	Reference value	Reference value	Reference value
Quartile 2	0.0005	-0.0055	0.0058	0.0022	0.0006	0.0080	-0.0044	-0.0021	0.0089
	(0.0046)	(0.0064)	(0.0067)	(0.0065)	(0.0067)	(0.0072)	(0.0071)	(0.0054)	(0.0101)
Quartile 3	-0.0097*	-0.0098	-0.0110	-0.0096	-0.0081	-0.0074	-0.0094	-0.0089	-0.0058
	(0.0056)	(0.0077)	(0.0080)	(0.0078)	(0.0080)	(0.0086)	(0.0085)	(0.0065)	(0.0115)
Quartile 4	-0.0017	0.0034	-0.0078	0.0045	-0.0082	0.0059	-0.0033	-0.0004	0.0012
	(0.0073)	(0.0101)	(0.0105)	(0.0102)	(0.0104)	(0.0112)	(0.0111)	(0.0088)	(0.0141)
Mean	4.0245	4.0245	4.0245	4.0245	4.0245	4.0245	4.0245	4.0245	4.0245
Standard deviation	0.8281	0.8281	0.8281	0.8281	0.8281	0.8281	0.8281	0.8281	0.8281
R-squared	0.2705	0.2495	0.2471	0.2662	0.2781	0.2569	0.2762	0.2067	0.1760
N (observations)	304 599	150 011	154 588	156 869	147 730	134 893	134 616	217 294	80 989

[8] The reason why the coefficients in this column will differ from the coefficients in table 4, model 6, is because we divide the child's own parents' education in smaller groups. We do not use the four different education levels we used in table 4. We now only have two levels – university education and no university education.

Table 6, part 2: Subsample analyses – controlling for school fixed effects

	Model 6		Model 7		Model 8		Model 9	
Dependent variable: GPA								
Subsample	Mother's education		Father's employment		Mother's employment		Parents marital status	
	(a) Mother no university education	(b) Mother university education	(a) Employed	(b) Unemployed	(a) Employed	(b) Unemployed	(a) Living together	(b) Not living together
Quartile 1	Reference value	Reference value	Reference value	Reference value	Reference value	Reference value	Reference value	Reference value
Quartile 2	0.0018	-0.0040	0.0015	-0.0127	0.0003	0.0116	-0.0007	0.0050
	(0.0054)	(0.0097)	(0.0047)	(0.0334)	(0.0048)	(0.0237)	(0.0052)	(0.0106)
Quartile 3	-0.0086	-0.0096	-0.0093*	-0.0083	-0.0098*	-0.0017	-0.0093	-0.0145
	(0.0066)	(0.0110)	(0.0056)	(0.0405)	(0.0057)	(0.0290)	(0.0062)	(0.0125)
Quartile 4	0.0022	-0.0083	-0.0018	0.0274	-0.0008	-0.0034	-0.0019	-0.0062
	(0.0089)	(0.0136)	(0.0074)	(0.0551)	(0.0074)	(0.0430)	(0.0081)	(0.0164)
Mean	4.0245	4.0245	4.0245	4.0245	4.0245	4.0245	4.0245	4.0245
Standard deviation	0.8281	0.8281	0.8281	0.8281	0.8281	0.8281	0.8281	0.8281
R-squared	0.2009	0.1766	0.2691	0.2966	0.2694	0.2743	0.2489	0.2432
N (observations)	215 048	83 208	296 883	7 716	291 885	12 714	237 428	67 171

Notes:
Estimates reflect results from OLS models, adjusted for school fixed effects, year fixed effects, child characteristics (birth month, gender, immigrant, lives with its parents, older and younger siblings and siblings born the same year) and parents' characteristics (education level, income, wealth, transfers, material status, employment status and age when the child was born). The standard deviations are in parenthesis. *, ** and *** denote significance at 10 percent, 5 percent and 1 percent level.
The treatment variable is dummies for the percentage of the child's peers having at least one parent with university education, divided in quartiles, as described in section 3 (empirical strategy).

5.2 Analysis with the examination grades

We wanted to examine further the school specifics which may cause our negative results. It is difficult to measure the quality at the different schools, but we can examine the teacher's grade setting more thorough. We wanted to examine further if there were systematic differences in the teachers' expectations and grade settings at the different schools. To study this we performed an analysis where the examination grades were the dependent variable.

The teachers' final assessment may not capture the real competence since it is a more subjective measure of the pupil's competence. The teachers' final assessment may be affected by for instance which teacher you have, who your peers are and your personal appearance. The examination grades may be better to use to capture the pupil's real competence because these grades will probably be a more objective measure of competence since the grade setter is external.

The dependent variable in this analysis was the written examination grades. The reason for using only the written examination grades was that the estimates became more precise compared to using both written and oral examination grades. The pupils normally have written examinations in the subjects English, Norwegian and mathematics, and we only took examination grades in these three subjects into consideration. When it comes to the written examination in Norwegian we chose to exclude the examination grade in Norwegian secondary language. The written examination in Norwegian then only consisted of the primary language. Most of the pupils in 10^{th} grade only have one written examination and we therefore chose to exclude the pupils who had a written examination in more than one of the three subjects of interest. After excluding the pupils mentioned above our final sample for this analysis consist of 296 460 pupils. The results from this analysis are presented in Table 7.

Table 7: Alternative dependent variable: How the learning environment affects the children's examination grades

	Model 1	Model 2
Dependent variable : GPA		
Quartile 1	Reference value	Reference value
Quartile 2	0.0188***	-0.0026
	(0.0050)	(0.0063)
Quartile 3	0.0215***	-0.0050
	(0.0050)	(0.0076)
Quartile 4	0.0689***	-0.0112
	(0.0053)	(0.0099)
Included control variables		
School fixed effects		X
Mean	3.4881	3.4881
Standard deviation	1.0724	1.0724
R-squared	0,2031	0,2206
N (observations)	296 460	296 460

Notes:
Models 1 and 2 are OLS estimates for the effect on the written exam grade of the learning environment. In Model 2 school fixed effects are controlled for. All estimates adjust for child, mother and father characteristics (as described in the text). The standard deviations are in parenthesis. *, ** and *** denote significance at 10 percent, 5 percent and 1 percent level.

The treatment variable is dummies for the percentage of the child's peers having at least one parent with university education, divided in quartiles, as described in section 3 (empirical strategy).

In Table 7, Model 1 the peer effect of being in a good learning environment is positive. Being in a learning environment where less than 27.03 percent of your peers have at least one parent with a university education (quartile 1) is the worst regarding your written examination grade. Being in a learning environment where 27.04-35.71 percent (quartile 2), 35.72-46.00 percent (quartile 3) or 46.01-100 percent (quartile 4) of your peers have at least one parent with a university education will increase your grades with 0.017σ, 0.020σ and 0.064σ, respectively, compared to being in quartile 1.

The results indicate that being a part of a learning environment where your peers have well educated parents is good for your school performance. The examination grades are getting more positively affected with increased percentage of the peers having parents with a university education. The results imply that the real competence is positively affected by being in a good learning environment. Being among peers with high educated parents are

positive for your real competence. These results imply that the parents should choose a school for their children with a good learning environment. These results are the opposite of the results in our main analysis using the final assessments (Table 4, Model 5). Because of the differing results the parents have to consider which competence is the most important for their children. The final assessments decide which school the child gets in to after the compulsory school. The examination grades might on the other hand be a more proper measure of the real competence. The real competence is probably more important in later education for example at the university and when starting working. Considering this the parents should maybe choose a school for their children with a good learning environment.

The two analyses with the GPA and the final assessments reveal peer effects with opposite signs. The analyses and their results imply that the reason for the negative effect in the main analysis is due to the teachers. There are probably systematic differences in the teachers' expectations and grade setting between schools. It appears to be more difficult to achieve good grades in a school with well-performing peers, than in a school with peers not performing so well. The teachers at schools with many well-performing pupils might be scaling down the grades and this makes it difficult to assert oneself among the peers.

In Table 7, Model 2, school fixed effects are controlled for in the analysis with the examination grades as the dependent variable. The results reveal no positive or negative peer effect. The estimates are close to zero. This is the same result revealed using the teacher's final assessment as the dependent variable. Since the examination grades may be a more proper measure of the real competence than the teacher's final assessment, the results in Table 7, Model 2, are probably the closest we get to capture the true peer effect. This is the true peer effect given our measure on the learning environment. The results reveal no peer effect. This indicates that the learning environment, as we measure it, does not influence the child's own school performance.

6. Generally about children's school performance

In this section we will discuss characteristics of the child and its parents and how they affect the children's school performance. These variables are included in the main analysis as control variables. The variables and their effect on the children's GPA are presented in Table 8. When discussing these variables we use the results in Model 2 since we in this model control for school fixed effects.

Table 8: Results of how other variables affect the children's school performance

	Model 1	Model 2
Dependent variable : GPA		
Child's characteristics		
Male	Reference value	Reference value
Female	0.3347***	0.3350***
	(0.0026)	(0.0025)
Immigrant	0.0706***	0.1056***
	(0.0081)	(0.0085)
Born in January	Reference value	Reference value
Born in February	0.0008	0.0015
	(0.0064)	(0.0064)
Born in March	-0.0150**	-0.0144**
	(0.0063)	(0.0062)
Born in April	-0.0143**	-0.0151**
	(0.0063)	(0.0062)
Born in May	-0.0399***	-0.0411***
	(0.0063)	(0.0062)
Born in June	-0.0473***	-0.0477***
	(0.0064)	(0.0063)
Born in July	-0.0752***	-0.0761***
	(0.0063)	(0.0063)
Born in August	-0.0824***	-0.0833***
	(0.0064)	(0.0063)
Born in September	-0.0952***	-0.0964***
	(0.0064)	(0.0063)
Born in October	-0.1185***	-0.1189***
	(0.0065)	(0.0064)
Born in November	-0.1276***	-0.1286***
	(0.0066)	(0.0065)
Born in December	-0.1300***	-0.1313***
	(0.0066)	(0.0065)
No younger siblings	Reference value	Reference value
One younger sibling	0.0677***	0.0586***
	(0.0033)	(0.0033)
Two younger siblings	0.1318***	0.1114***

	(0.0048)	(0.0048)
Three younger siblings	0.1617***	0.1310***
	(0.0099)	(0.0099)
Four younger siblings	0.2152***	0.1887***
	(0.0244)	(0.0243)
Five or more younger sibling	0.2811***	0.2737***
	(0.0380)	(0.0379)
No older siblings	Reference value	Reference value
One older sibling	-0.0487***	-0.0552***
	(0.0054)	(0.0053)
Two older siblings	-0.0412***	-0.0594***
	(0.0082)	(0.0081)
Three older siblings	-0.0499***	-0.0793***
	(0.0108)	(0.0108)
Four older siblings	-0.0606***	-0.0899***
	(0.0170)	(0.0169)
Five or more younger siblings	-0.0588***	-0.0820***
	(0.0214)	(0.0213)
Being a twin, tripling etc.	0.0778***	0.0794***
	(0.0090)	(0.0089)
Having younger siblings born the	-0.1619	-0.1839*
same year as you	(0.1014)	(0.1003)
Having older siblings born the	-0.1874	-0.2182*
same as you	(0.1183)	(0.1170)
Born in 1986	Reference value	Reference value
Born in 1987	0.0274***	0.0230***
	(0.0047)	(0.0047)
Born in 1988	0.0348***	0.0300***
	(0.0047)	(0.0047)
Born in 1989	0.0423***	0.0342***
	(0.0047)	(0.0047)
Born in 1990	0.0196***	0.0108**
	(0.0048)	(0.0048)
Born in 1991	-0.0060	-0.0175***
	(0.0049)	(0.0050)
Living without its parents	-0.0299	-0.0258
	(0.0196)	(0.0194)
Mother's characteristics		
Education: Compulsory school	Reference value	Reference value
Education: High school graduate	0.2224***	0.2250***
	(0.0034)	(0.0033)
Education: University education	0.3710***	0.3722***
	(0.0038)	(0.0038)
Education: Master's or doctor's	0.4328***	0.4379***
degree	(0.0087)	(0.0086)

Income	4.30e-07***	4.48e-07***
	(1.88e-08)	(1.88e-08)
Wealth	1.81e-08***	1.84e-08***
	(1.80e-09)	(1.79e-09)
Transfers	-2.06e-06***	-2.09e-06***
	(1.15e-07)	(1.14e-07)
Unemployed	-0.0413***	-0.0488***
	(0.0066)	(0.0066)
Divorced	-0.1090***	-0.1029***
	(0.0045)	(0.0045)
Age (when child was born)	0.0520***	0.0588***
	(0.0029)	(0.0028)
Age different between child and oldest sibling (teenage mum)	-0.0213***	-0.0228***
	(0.0016)	(0.0016)
Father's characteristics		
Education: Compulsory school	Reference value	Reference value
Education: High school graduate	0.1558***	0.1587***
	(0.0031)	(0.0031)
Education: University education	0.3346***	0.3411***
	(0.0041)	(0.0041)
Education: Master's or doctor's degree	0.4084***	0.4212***
	(0.0057)	(0.0057)
Income	2.04e-07***	2.58e-07***
	(9.47e-09)	(9.60e-09)
Wealth	1.47e-08***	1.38e-08***
	(8.99e-10)	(8.90e-10)
Transfers	-2.54e-06***	-2.46e-06***
	(8.55e-08)	(8.48e-08)
Divorced	-0.1090***	-0.1029***
	(0.0045)	(0.0045)
Unemployed	-0.0393***	-0.0421***
	(0.0085)	(0.0084)
Age (when child was born)	0.0239***	0.0226***
	(0.0020)	(0.0020)
Included control variables		
School fixed effects		X
Mean	4.0245	4.0245
Standard deviation	0.8281	0.8281
R-squared	0,2667	0,2892
N (observations)	304 599	304 599

Notes:
Models 1 and 2 are OLS estimates for the effect on the GPA of the characteristics of the child and its parents. In Model 2 school fixed effects are controlled for. The standard deviations are in parenthesis. *, ** and *** denote significance at 10 percent, 5 percent and 1 percent level.

First we will consider variables concerning the child. We found that birth month, gender and ethnicity are child characteristics which influence the performance at school. Our results show that it is favourable to be born early in the year, rather than late. This is consistent with some of the literature on this subject (Crawford, et al., 2007; Strøm, 2004). Others have found no evidence of a correlation between relative age and achievement (Cascio & Schanzenbach, 2007). In our study the GPA get reduced by 0.159σ being born in December rather than in January. The relationship between birth month and the child's GPA is almost linear. The effect of birth month on the GPA is statistically significant.

When it comes to the gender we found that girls achieve a GPA which is 0.405σ higher than the boys' GPA. The coefficient is statistically significant. This result is similar with existing literature on gender and school performance (Atkinson, et al., 2008; Summers & Wolfe, 1977). But it must be said that some studies found difference in the genders performance regarding the different subjects. The main findings are that girls do better on reading and verbal tests, while boys get the best math test scores (Hedges & Nowell, 1995).

We also found that being an immigrant has a positive and statistical significant effect on the school grades. Being an immigrant raises the GPA with 0.128σ. This is the opposite result of what Steffensen and Ziade (2009) found in their summary of the school results in Norway from the year 2008.

Many studies have found that family size and birth order have significant effects on the children's school performance (Behrman & Taubman, 1986; Black, Devereux, & Salvenes, 2005; Wolter & Vellacott, 2002). Our results suggest that having younger siblings have a positive and statistically significant effect on the child's GPA. Having one, two, three, four or more than four younger siblings increases your GPA with 0.071σ, 0.135σ, 0.158σ, 0.228σ and 0.331σ, respectively, compared to having zero younger siblings. On the other hand having older siblings have a negative and statistically significant effect on the GPA. Going from having zero to having one, two, three, four or more than four older sibling decreases your GPA with 0.067σ, 0.071σ, 0.096σ, 0.109σ and 0.099σ, respectively. This shows that being the firstborn is an advantage. This is consistent with earlier studies on this subject (Hanushek, 1992; Wolter & Vellacott, 2002).

Being a twin, triplet etc. also has a positive and statistically significant effect on the child's school performance, raising the GPA with 0.096σ. On the other hand, having a sibling born the same year as you, without being a twin, triplet etc., has a negative effect on the school performance. The effect on the GPA is a reduction of 0.222σ if the sibling is younger than you and a reduction of 0.263σ if the sibling is older than you. However, the effect of having younger or older siblings born the same year as you is not statistically significant.

There are also other family variables affecting the children's performance at school. Living with neither of your parents, for example being a child who lives in foster care or in an orphanage will reduce the GPA with 0.031σ. This coefficient is however not statistically significant.

The next group of variables affecting the children's school performance is the parental characteristics. First we will examine the education level of the child's own parents. An important and acknowledged result in the literature regarding this subject is that there is a large and positive relationship between parental education and children's school achievement (Haveman & Wolfe, 1995; V. Henderson, et al., 1978; Jacobs & Harvey, 2005). Our results support this literature and confirm that the education level of the child's own parents have a strong effect on the child's school grades. The higher education level the child's parents have the better grades the child achieves.

Both parents education have a positive and significant effect, but the effect of the mother's education is slightly larger than the effect of the father's education. Having a father with a high school degree will raise the grades to the child with 0.192σ, compared to having a father with only compulsory school. The father's education going from compulsory school to a bachelor's degree increases the GPA with 0.412σ, and going from compulsory school to a master's degree or a PhD increases the GPA with 0.509σ. When it comes to the mother's education level the gain in the child's GPA going from compulsory school to high school graduate, a bachelor's degree, or a master's degree or a PhD is 0.272 σ, 0.449 σ and 0.529σ, respectively.

The next variable which has an impact on the children's school achievement is the parental resources. The main results on this relationship are that parental resources have a positive impact on the children's performance (Hill & Duncan, 1987; Plug & Vijverberg, 2003). On

the other hand some earlier studies have found a negative or little effect of the parental resources on the children's outcome (McEwan, 2003; Raaum, 2003).

Our results suggest that the parents' income and wealth have a positive and decreasing effect on the child's school performance, though stronger in the case of mother's income and wealth. For every 100.000 NOK the father earns and for every 100.000 NOK he has in wealth, the child's GPA will increase with 0.031σ and 0.002σ, respectively. The effect on the child's GPA of every 100.000 NOK the mother has in income and wealth is 0.054σ and 0.002σ, respectively. On the other hand the transfers (representing for example social security benefit, unemployment benefit and child support payments) have a negative and increasing effect on the child's GPA, and the father's transfers have the greatest impact. For every 100.000 NOK the father and the mother have in transfers, the child's GPA will decrease with 0.297σ and 0.252σ, respectively. All six coefficients are statistically significant.

Another variable that influence the children's school grades is the parents' employment situation. The literature regarding this variable is divided. Coelli (2004) concluded that a sudden unemployment have negative impacts on the school performance of youth. Kalil and Ziol-Guest (2008) concluded that fathers' involuntary unemployment was related to a higher possibility of children's grade repetition and exclusion from school, but they found no relation between mothers' employment and children's academic progress. In contrast Hill and Duncan (1987) found that working mothers appear to have significantly less successful sons, when it comes to completed education and wage rate. On the other hand Hanushek (1992) concluded that increased work by mothers had no apparent impact.

Our study finds that the children's achievement is affected in a negative way if the parents are unemployed and searching for a job. Having a father who is unemployed reduces the child's GPA with 0.051σ, while having a mother who is unemployed has a slightly bigger affect and reduces the GPA with 0.059σ. Both coefficients concerning employment status are statistical significant.

Other parental characteristics are whether the parents live together or not and the parents' age when the child was born. Children with parents living together have a GPA which is 0.124σ higher than the GPA of children with parents who do not live together (e.g. divorced or separated). The coefficient is statistically significant. The result is similar to the conclusion in

the research of Amato and Keith (1991). Their results revealed that children of divorced parents scored lower than children in intact families in multiple outcomes, one of them being school achievement.

Our results also revealed that children with older parents perform better at school than children with younger parents, but the effect is decreasing. The positive effect of an increase in the father's age is less than half of the effect of an increase in the mother's age. The mother's age is accordingly more important for the children's GPA than the father's age. For each year added to mother's age when the child is born, the child's GPA increases with 0.071σ. The increase in the GPA of each year added to father's age when the child is born is only 0.027σ. Both coefficients concerning the parents age are statistically significant.

We also found that age difference between the child and the child's oldest sibling has an impact on the child's performance. The bigger the age difference, the lower the GPA, and the effect is statistical significant and increasing. For each additional year there is between the child and the child's oldest sibling, the grade will decrease with 0.028σ. The higher the age difference is the younger the mother was when having her first born child. The results suggest that it is not favourable to have a mother who got pregnant at a young age.

The results from this analysis show that there are many characteristics of the child and its parents affecting the children's school performance. The variables having the largest impact are gender, birth month, having younger siblings and the parental education. Being a female increase the GPA with 0.405σ, and being born in December decreases the GPA with 0.159σ compared to being born in January. Having younger siblings increases the school performance; the several younger siblings you have, the higher the GPA gets. The mother's and the father's education also have a great impact on the school performance; the higher the parents' education is, the better for the children's GPA.

7. Conclusion

There is a range of existing literature concerning peer effects and how the learning environment affects the children's school performance. Much research has shown that there is a positive effect of being among high ability peers. The opposite view is that if you are attending a school with high achieving peers, it will have a negative effect on your own school performance. The weak pupils' self-esteem may be reduced since their peers are performing relatively better than themselves. The effect is also relevant for the higher achieving pupils since they have fewer weak pupils to compare themselves with.

Our results when not controlling for school fixed effects show that the effect on GPA of being in a good learning environment is negative. This indicates a negative peer effect. The children's grades are negatively affected by attending a school were the parents have high education. When it comes to the parents' choice of school for their children it seems like attending a school with a bad learning environment is favourable for the child's GPA.

The negative estimates revealed could however also be due to school specifics not controlled for in the regression. One possible school specific explaining the results is the school quality. Schools where the parents have high education might in fact be worse than schools where the parents have lower education. There might also be a selection problem. Parents with high education may move to more expensive areas were they assume that the schools are of high quality. The quality in these schools may not be as high as expected, and this may lead to our negative results. Another possibility is that it may be harder to achieve good grades when you are in a school where your peers are performing well. The teacher will compare your tests with the tests to other well-performing pupils.

To explore the different mechanisms which could cause our negative results we carried out some other analyses in addition to the main analysis. We carried out subsample analyses, controlled for school fixed effects in the main analysis and performed an analysis using the examination grades as the dependent variable. The results from the subsample analyses revealed that the negative results most likely were not caused by selection of pupils into schools. When controlling for school fixed effects in the main analysis the estimates became close to zero. This indicates no peer effect. In other words there was no correlation between

the learning environment and the GPA. The results from this analysis show that the negative effect in the previous analysis was due to school specifics.

In the analysis where the examination grades were the dependent variable the results indicate a positive peer effect. The examination grades get positively affected by a good learning environment. This was the opposite of what we found using the teacher's final assessment as the dependent variable. The results therefore suggest that the teacher's grade setting was the reason for the negative results in the main analysis. The results from the analysis with the examination grades suggest that it is favourable for the children's real competence to attend a school with a good learning environment. Considering the parents' choice of school for their children it seems like attending a school with a good learning environment is favourable for the child's real competence.

When using the examination grades as the dependent variable and controlling for school fixed effects the estimates changed as in the main analysis; they became close to zero. This indicates no peer effect. The examination grades are probably a more proper measure of the pupil's real competence and these results are therefore the closest we get to the true peer effect. If this is the true peer effect, the children's school performance is not affected by their peers. The learning environment, as we measure it, does not have an impact on the children's school performance. Attending a school with a good learning environment or a bad learning environment does not affect the children's school performance.

However, it is important to take into consideration that the results may be affected by an unsatisfying measure of the learning environment. It might be that the education of the peers' parents does not capture the true peer effect.

Since our measure might not capture the true peer effect, it would for further research be interesting to use another measure of the learning environment. A way to find a proper measure may be to carry out ability tests for every child before beginning at school. This would have been a correct measure of the peers' ability, and a possible measure of the learning environment. Today there are no such tests performed in Norwegian schools, and using this measure may therefore up to date be difficult to carry out.

It might also be of interest to examine the systematic differences in the school quality. The quality could be studied by for instance measuring the teacher's education and the amount of received governmental support. By studying this more thorough, the mechanisms causing our negative results in the main analysis will be more apparent.

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