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The Effect of Ordinal rank in Dutch Primary schools on Secondary school Performance

Name student: Bakar Boateng
Student ID number: 542664

Supervisor: Dana Sisak
Second assessor: Saeed Badri

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Bakar Boateng

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Abstract

This paper examines the effect of ordinal rank in the last year of primary school on grades in the third class of secondary school in the Netherlands. This is done by making use of COOL$^{5\text{-}18}$ cohort data in which 4025 students are followed between 2007 and 2014. Our most extensive regression shows that ordinal rank increases students' grades for Mathematics. A one standard deviation increase in ordinal rank causes a change of 0.155 standard deviations in Math score. When we look at the grades for Dutch, however, we do not find an effect of ordinal rank. The effect of rank on secondary school performance shows to be mediated by parental investments. Since there is no heterogeneity found in the rank effect, the possibility of redistribution students for a positive net effect is excluded. However, this paper adds to literature by showing that rank effects also exist in the Dutch educational system and the effect continues even when a student has a new set of peers. This research also shows the importance for controlling for if a student needs extra guidance.

Keywords: Rank, Dutch education, Peer effects

1. Introduction

Student performances in the Dutch education system have declined in the past years (Inspectie van het Onderwijs, 2018). This while the expenditures per student have risen (van der Steeg et al., 2011). In 2021, 3.8% of the Dutch GDP, which is equivalent to about 24.4 billion, was spend on education (Ministry of Finance, 2022). As Hanushek (1997) argues, simply assigning more resources to schools is not always the solution for improving student achievements. With rising expenditures and a limited budget, it is necessary to examine factors that influence the performances of Dutch students.

Analyzing the effectiveness of education policy can be challenging. Sometimes findings of studies on the same subject show different results. In addition, research is often conducted abroad, which means that it is sometimes unclear what effect it has in the Netherlands. To draw the right conclusions, it is therefore important to use research from a similar context or to translate findings as well as possible to the context in question (van Elk et al., 2011).

This paper contributes to literature on the improvement of performances in the Dutch education system by shedding more light on the effect of ordinal rank on educational performance. This is done by a regression analysis in which the effect of ordinal rank in grade 8 of primary school on the grades in third class of secondary school is estimated for students at Dutch schools. To do this data of the COOL$^{5\text{-}18}$ cohort studies[1] is used. This dataset makes it possible to follow the development of students over time.

This leads us to the following research question:

What is the effect of ordinal academic rank in primary school on educational outcome in secondary school for Dutch students of the COOL$^{5\text{-}18}$ research?

Previous research on ordinal rank was mainly done in other countries. In England, for example, Murphy and Weinhardt (2020) found that ordinal academic rank during

[1] In this paper COOL will be used to refer to this cohort study to improve the readability.

primary school, controlling for underlying ability of the students, has impact on secondary school performances. Among other factors, they found effects of ordinal rank on test scores and subject choices, even though students were in a new environment with different peers and teachers. In the Netherlands there is one previous study on ordinal rank. Van de Ven (2019) showed, using panel data from the PRIMA cohort study, that ordinal rank in the first years of primary school has a positive effect on both test scores and school advice at the end of primary school.

This research will add to the scarce literature on the effect of ordinal rank in the Dutch education system and will thereby examine a newer cohort dataset where, contrary to other Dutch cohort studies, data of both primary and secondary school students is available. The focus will be on the effects of ordinal rank on secondary school performance, which have not been examined before in the Dutch setting. In this way we account for possible differences between the education systems of countries and estimate an effect that is more realistic to the Dutch context. There is also an introduction of a new control variable for students in need of extra guidance.

The main findings of this paper are that a higher primary school ordinal rank in Mathematics increase the performances in this subject in the third class of the secondary school. The results show that a one standard deviation higher rank increases the Math grade with 0.155 standard deviations. This estimation is statistically and economically significant, as the effect is comparable to almost twice effect that Murphy and Weinhardt (2020) found in a similar setting in England. For the subject Dutch, the most extensive model estimates that an increase in rank does not increase the score in the third class. This paper shows that ordinal rank is relevant in Dutch context and is an important factor to consider when looking at student performance.

The rest of this paper has the following structure: Section 2 discusses the existing literature. Section 3 discusses the data used in this research and Section 4 introduces the methodology for answering the research question. Afterwards, the results are presented in section 5. Section 6 discusses the findings of this paper and in Section 7 the conclusions of this research are presented.

2. Literature review

This section discusses the existing literature on educational performances. This will be literature of various education levels and from different countries.

2.1 Literature on educational performance

There has been an extensive amount of literature on the improvement of educational performances. Various papers, for example, examined the effect of class size on students' achievements. The most prominent setting being the Tennessee STAR experiment performed in the 1980s. The unique thing about this project is that it was a large-scale randomized experiment. Over four years, 11600 elementary school students were assigned in classes with different class sizes. Based on data of this experiment, Nye et al. (2000) find that the mathematics and reading grades of students increased between 0.15 and 0.3 standard deviations for being in a small class (13-17 students). Looking at the effect of the STAR experiment on high school grades, Krueger and Whitmore (2001) find that students in small classes score 0.1 standard deviations higher than regular size (22-25 students) classes.

It is important to note, however, that there were also some concerns with the STAR experiment. For example, a part of the students was re-randomized because of parental complaints. Furthermore, there was attrition of almost half of the students (Krueger, 1999). Nevertheless, Krueger (1999) argues that the experimental issues of the STAR experiment do not change the findings.

There are also papers on class size and student performance that find no statistically significant effect or even a negative effect. These papers often use a non-experimental method, since the STAR experiment is unique in its sort (Hanushek, 1999; Hoxby, 2000a). Therefore, there is uncertainty about whether class size reduction improves student performance and, if so, to what extent (Averett and Mclennan, 2004). However, based on the STAR experiment and other papers that do find a positive significant effect, it is often believed that smaller classes increase the performance of students (Hanushek, 1999; Nye et al. 2000).[2]

[2] For example, Dutch reports of Ter Weel et al. (2020) and CPB Netherlands Bureau for Economic Policy Analysis (2016) conclude that there is an effect of class size on student performance.

Other ways to improve educational performance show more congruent findings. For example, Nye et al. (2004) show that being taught by a better teacher increases student performance. Having a very effective teacher is found to raise reading scores with 0.33 standard deviations and Mathematics scores with 0.46 standard deviations, compared to having an average teacher. Furthermore, research shows that parental involvement also positively impacts educational achievements (Wilder, 2014; Rafiq et al., 2013; Castro et al., 2015).

2.2 Peer effects on educational performance

But what about interventions within the classroom? Several studies have shown that putting children in a classroom with high performing peers causes an increase in performance compared to a class with different performance levels (Hoxby & Weingarth, 2005; Sacerdote, 2011). Based on a field experiment on Kenyan primary schools, Duflo et al. (2011) found, assuming linear effects, that students had an 0.52 standard deviation increase in test score when the average peer test score was one standard deviation higher. Besides that, they (2011) observe that students that were assigned to a class based on performance scored 0.14 standard deviations higher after 18 months. Other papers (Burke & Sass, 2013; Sund, 2009; Carrell et al. 2009) do even find evidence of non-linear peer effects on student achievements.

Literature also shows that having a higher proportion of females in a classroom increases educational performance for boys and girls (Sacerdote, 2011). For example, Hoxby (2000b) finds, looking at data on primary schools in Texas, that boys and girls show better grades for Math and reading when having more females in the peer group. Lavy and Schlosser (2007) examine gender peer effects in Israel for primary, middle, and high school. According to their estimation, in primary school, a 10-percentage point increase in the proportion of females increases the Math scores of girls with 0.037 standard deviations and with 0.022 for boys. In high school, they find that an increase of 20-percentage point in proportion of females in a classroom increases the average test score with 0.04 to 0.05 standard deviations.
Although girls tend to outperform boys and thereby increase average performance, which could cause other students to also perform better, both papers (Hoxby, 2000**b**; Lavy & Schlosser, 2007) state that this effect is unlikely to be caused by this.

There is also literature on peer effects in the form of disruptive peers. Carrell and Hoekstra (2010) examined children from families in which domestic violence was present and showed that disruptive children tend to negatively affect the reading and Math performance of their peers. They report that a disruptive child added to a class of 20 students decreases the performance by 0.2 standard deviations.
Carrell et al. (2018) later found that having a disruptive student during primary school also decreases high school performance. They report that adding a disruptive peer in a class of 25 in primary school decreases high school results of Math and reading with 0.02 standard deviations and decreases student's earnings in their mid 20s with 3 to 4 percent.

2.3 Effects of ordinal rank on educational performance

Ordinal rank could be seen as another dimension of peer effects. If assigned with higher performing peers, a student with the same set of ability will drop in ordinal rank. Unlike many other factors that influence performance, rank is something that affects every student in a class. But why would someone care about this? Powdthavee (2009) argues that ordinal rank is an important factor in how people perceive their social standing. Therefore, based on information on rank, people with certain ordinal rank might believe that their ability is better/worse than it is in reality, which might cause them to perform better/worse. Several papers (e.g., Denning et al., 2021; Murphy & Weinhardt, 2020) describe reacting to the ordinal rank as a heuristic, since a student reacts to their ordinal rank instead of their actual ability. Elsner et al. (2021) also observed an asymmetric effect in this heuristic, in which students tend to only respond to positive signals. Bertoni and Nisticò (2019) find, based on data of two randomized experiments, that not controlling for ordinal rank when estimating the effect of average peer abilities causes significant bias.

2.3.1 Primary school

Murphy and Weinhardt (2014) were one of the first to examine the effect of ordinal rank on educational outcomes. With panel data of English primary schools, they compared students within cohorts and found that ordinal academic rank during primary school has a positive impact on secondary school performances, controlling for underlying ability of the students. Among other factors, they found effects on test scores and subject choices, even though students were in a new environment with different peers and teachers. When looking at the magnitude of the effect they find that an ordinal rank of one standard deviation higher increases the educational performance at the age of 14 and 16 with around 0.08 standard deviations. Denning et al. (2021) looked at effects of ordinal rank over a longer period. They examined the ordinal rank of children in primary schools in Texas and followed them through until their mid-twenties. Their paper shows that students with a higher ordinal rank earn more later in life. A student being in the 75th percentile compared to the 25th percentile showed to have an increase in income in their mid-twenties by 7 percent.

2.3.2 High school

Elsner and Isphording (2017) looked at US students in high school and found that students with a higher ordinal rank are significantly more likely to finish high school and to attend college. They also estimate that higher rank increased the probability of graduating with a 4-year degree.

2.3.3 College

Elsner et al. (2021) show that college students with a higher ordinal rank perform better and make different specialization choices. For example, student with a higher rank in a course more often choose to take the follow up course of this subject. They suggest that students who are unsure of their ability tend to take their rank into account in important choices. Besides this, they find that a one standard deviation increase in ordinal rank raises student performances by 0.07 standard deviations.

2.4 Ordinal rank in the Dutch context

As for as is known, there is only one paper on academic rank effect on educational outcome for the Dutch education system. In this paper van de Ven (2019) examines, using longitudinal (PRIMA) data from primary schools, how ordinal rank in grade 2 children effects students' test scores and school advice in the 8th grade. She estimated that a one standard deviation higher ordinal rank for Math increased the Math test score with 0.226 standard deviations. For Dutch this increase was 0.083. The ordinal rank also showed to cause higher school advice, which decides the secondary school level a student can go to after primary school. She also discusses the effort of students, the investment of teachers and the confidence level of students to be possible factors that drive this effect.

One of the ways in which this paper contributes to existing literature, is that it adds to the scarce academic literature on ordinal rank effects in the Dutch school system. As Ter Weel et al. (2020) mention, findings of academic literature can often not directly be translated to Dutch education. Dutch students are likely to differ from students elsewhere in the world. Furthermore, The Dutch education system has some unique characteristics. It is known as one of the most autonomous systems in the OECD. This shows itself in a system in which 86% of the decisions are made by schools themselves. Schools have relatively much freedom to decide their curriculum, which enables students and parents to choose which school fits them the best (OECD, 2016). Also, the Netherland has the debated early tracking, in which students are grouped by ability after primary school at an age of 12. This means that students get into a new class with a (partly) new set of peers after 8 years of primary education. These students are expected to have similar skills as their peers. In addition to this, the high level of autonomy also makes it possible for schools to have their own set of criteria when accepting students.

This paper will examine a newer data set, with more recent observations, where contrary to other cohort studies, data of both primary and secondary school students is available. This research will look further into the effect of ordinal rank by looking at the effect on secondary school outcomes and examine if rank effect holds when the student is in contact with new group of peers and teachers.
Based on previous papers, it is expected that ordinal rank positively effects the students' performances in secondary school. This would show that also in the Dutch context ordinal rank is something to consider when addressing peer effects.

2.5 Ordinal rank on non-academic outcomes

Ordinal rank also seems to influence non-academic factors. Elsner and Ishpording (2018) find that a lower ordinal rank in high school increases the probability of risky behavior, like smoking, drinking, unprotected sex and getting into physical fights. They do this by looking at panel survey data of US high and middle school students.

3. Data

In this section the data used for this paper is discussed. Furthermore, the selection of the sample, the variables used, and a brief overview of the Dutch education system are given.

3.1 COOL$^{5\text{-}18}$ data

For this research, data of the COOL$^{5\text{-}18}$ (Cohort Onderzoek OnderwijsLoopbanen onder leerlingen van 5 tot 18 jaar) cohort studies is used. The data is retrieved from the Data Archiving and Networked Services (DANS); a repository of research data that makes data publicly available. As far as is known, this is the most recent publicly available dataset on Dutch primary and secondary school students.

In the Netherlands there have been several cohort studies on education. For example, the PRIMA cohort study followed primary school pupils in six waves during grades 2, 4, 6 and 8 in the years 1994/1995 (PRIMA I) to 2004/2005 (PRIMA VI). Subsequently, the COOL was introduced, in which children aged 5 to 18 years were followed in primary education in grade 2, 5, 8, the third class of the secondary school and at the end of the secondary school (HAVO 5 or VWO 6). The COOL 5-18 had 3 rounds: 2007/2008, 2010/2011 and 2013/2014. However, in the first round, data of students at the end of their secondary school education was not collected. Cohort research like the COOL maps the school career of students and makes it possible to investigate developments over time due to treatments such as academic rank.

Using the COOL data, this research aims at looking at the effect of ordinal rank in grade 8 on the educational outcomes in the third year of secondary school. Figure 1 provides a brief overview of the educational system in the Netherlands.

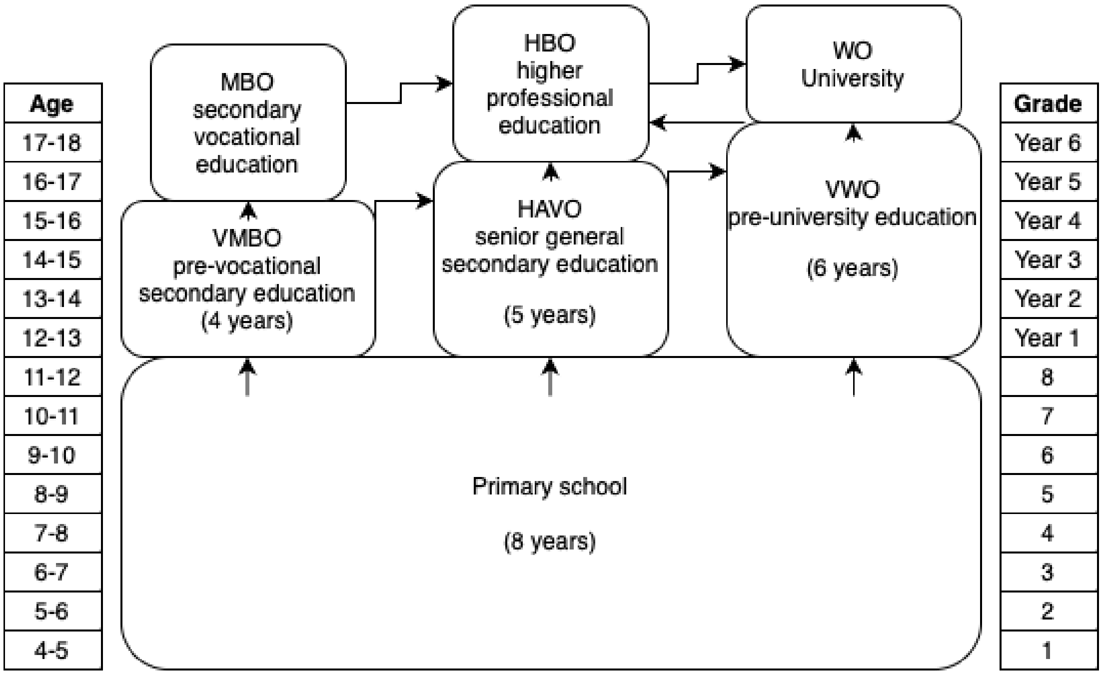

Figure 1: School system in the Netherlands

Notes: A short overview of the school system in the Netherlands. After grade 8, students leave the primary school and go to a new secondary school. Primary school achievement and the teacher's advice decide which secondary school level the students can attend. Arrows indicate steps that can be made in the educational system. Practical training has been excluded for simplicity.

In the Dutch education system, most children start primary school at age 4. They continue primary school until age 11/12, which is when they are in the 8th grade. In grade 8, the students in the sample made a decisive test (the Cito final exam) which determined the advice they got for the level they can attend in their secondary education.[3] The secondary school choices are based on this school advice which are based on the performance in the last grade of primary school. This means that primary school students that perform well are expected to go to a higher-level secondary school. In this, VMBO is assigned to the lower scores, HAVO to the slightly higher scores and VWO to the highest scores. Depending on your level, secondary school can take as long as 4-6 years. The level you are doing also determines how you can continue your academic path after your secondary school.

[3] It is important to note that this has slightly changed since 2015. The role of the Cito final exam has changed, and students get their advice based on the teacher's judgement and the students results for exams in grade 6, 7 and 8. Nevertheless, ordinal rank is still a valid proxy for the student's day-to-day rank within a classroom. This will be discussed more extensively in Section 6.

For example, by finishing VWO you have a direct access to study at the university (WO) (Ministry of Education, Culture and Science, 2021).

The dataset consists of students grades on Cito tests in the middle of class 8 as well as the final Cito test at the end of primary school. For the third year of the secondary school there are also grades reported for several subjects which were tested. Besides this, the COOL dataset also provides other data on student characteristics, such as age, gender, and school characteristics such as province and if the school is in an urban area. There are also parents and student survey questions added, which give additional information on the student and their behavior.

3.2 Sample selection

In each of the 3 waves of the COOL study, data was collected from 10 000-12 000 students from 450-550 schools at the end of primary school. The COOL researchers tried to follow these students through secondary school, but they were not always successful. Although they prioritized recruiting schools where they knew there were students who were more likely to participate, some high schools chose not to participate in the study. In some cases, secondary schools also rejected the request that only old-COOL participants would take the third-year test for the research. As a result, about 10 to 12 percent of the children measured in the last grade of primary school were also measured in the third year of secondary school.

Since have data on 3 waves, there are 2 cohorts that can be formed. The first cohort exists of students that were in grade 8 in the academic year 2007/08 and the third class of secondary school in 2010/11. The second cohort exists of children that were in grade 8 in 2010/11 and the third class of secondary school in 2013/14. Looking at cohort 1, 2646 students were included and in cohort 2 this was 1571. Like other papers (Van de Ven, 2019; Murphy and Weinhardt, 2020), we drop observations from classrooms with less than 10 students as they might not be representative for Dutch schools. When we drop these students, we have 4025 observations left, with 2526 of the first cohort and 1499 of the second cohort. If the exact age of a student was missing, the year of birth was subtracted from the cohort year to calculate their age. This was done for 21 of the 4025 children.

3.3 Variables

We go on with describing the most important variables for our analysis in more detail.

Ordinal rank

Because we want to examine ordinal academic rank, we first look at descriptions of ordinal rank used in earlier papers. For this, one should think about two identical people in two different classrooms. The classes differ in the ability distribution such that one of the two people has a higher rank than the other. It is hypothesized that even though the two persons are identical, the differences in rank can cause differences in their educational performance. As van de Ven (2019) states, in a perfect world there would be no effect, as students would be completely aware of their own ability and that of their peers. However, in practice one can argue that this is not always the case and students and even teachers and parents are not fully aware of their ability and their rank. In this case the perceived rank can influence students and their performance.

As we are interested in the causal effect of rank on educational outcome, we need to rank every student based on test scores. From other papers about ordinal academic rank (e.g., Murphy & Weinhardt, 2020; Elsner and Isphording, 2017; van de Ven, 2019) this formula is used to know the academic rank:

$$Percentile\ rank = \frac{\text{absolute rank} - 1}{\text{nr of students in classroom} - 1} \qquad (1)$$

For this student's grades of Mathematics and Dutch, two of the main courses in the Dutch school system, will be used. Following the argument of Denning et al. (2021), we see this measure as a proxy for the daily rank of a student within the classroom. Students (and also teachers and parents) would learn more about this rank, the more they interact with each other.

In Dutch primary schools, children usually have every subject with the same set of peers. Therefore, the classes are composed based on the class name given in the

COOL dataset. In some schools the students of grades 7 and 8 are combined[4]. This could have some implications as students might also compare themselves with grade 8 students even though they are not officially in the same year. We calculate a rank based on the student's position in class compared to others in the same grade. However, from the group name we can deduce whether the student is in a mixed class or not.

Final Cito test scores

For our main analysis we will use the final Cito exam to control for previous achievement and compute the ordinal rank. This test was made by more than 80% of the Dutch primary schools (Driessen et al., 2009). The test has 3 mandatory components: Dutch, Mathematics, and study skills. The primary school final test of Math had a maximum score of 60 and that of Dutch a maximum score of 100. There is also a total score computed based on the sum of the scores of these three components. The score is between 500 and 550, and it determines which secondary school a student can attend. This test is externally graded and is taken during the same (three) days nationwide.

Mid-grade 8 test scores

We also have mid-grade 8 exams, which are used to measure the development of the children. The Cito prescribed the period in which the test had to be taken and schools could then choose when they would take it. In this research we focus on the tests of Math and Dutch. These exams can be seen as low stake test because, in contrast to the Cito final test, the results of this test have no direct consequences for the students. With these mid-grade 8 exams, there were multiple versions available of the test. Therefore, the scores are not directly comparable, but the ordinal rank can be compared. We will use this to check the robustness of our results. The test is graded by the teacher following instructions of the Cito.

Secondary school third class exams

In the third-class, students in the COOL took exams for Dutch and Math. Since, there are no direct consequences to the performance on this exam, these exams could

[4] in some cases, students of grade 8 are also included.

also be seen as a low stake test. Similarly, to the mid-grade 8 test, schools had more flexibility in when they wanted to take the exams. Because of the differences in track in the Dutch secondary school system, the exams had partly overlapping questions. In this way children that made different versions could still be compared with each other. In addition to the points obtained, the COOL researcher provide ability scores, which measure the ability of the student based on their test score which is comparable across test versions. These scores will be used as our outcome variable.

Socio-ethnic background

Then we have socio-ethnic background (SES). This variable was computed by the COOL researchers, and it combines the education level with the ethnic background of the student's parents. It divides parents by Dutch or non-Dutch and by education level, which could be maximum lower vocational education[5], maximum MBO and maximum HBO/University. This leads to six categories: Max. lower vocational education & non-Dutch (1), max. lower vocational education & Dutch (2), max. MBO & non-Dutch (3) max. MBO & Dutch (4), max. HBO/University & non-Dutch (5) and max. HBO/University & Dutch

Student in need of extra guidance

Additionally, we also look at a dummy variable indicating if there is extra guidance for the student. Following the definition of the paper of Roeleveld et al. (2013), this is a student that: "has a specific problem or a specific limitation, and/or for whom extra guidance or attention is required, and/or for whom an individual action plan has been drawn up". In their research (2013) they find that these students score lower on average in primary school. In the COOL data a student is classified as student that needs extra guidance based on the survey answers of the teacher.

3.4 Sample description

The descriptive statistics are presented in Table 1. The average age of the students is 15 years. This is congruent with the age that fits with students of the third class, which is between 14 and 15. There are almost as many males as females. The

[5] This was abolished in 1992 and is comparable to the current VMBO (Dienst Uitvoering Onderwijs, n.d.).

average number of students in a class is 22. For most students, both of their parents are Dutch. We also see that 21% of all children is classified as students that need extra guidance. Looking at education level we see that the education level of father and mother are similar.

The average ordinal rank for Math and Dutch are slightly above the expected value (0.500). This could be because not every student is considered, as ordinal rank is based on primary school class, while the sample exists of students that are also measured in secondary school. This suggests that we have slightly more above average ranked students in our sample.

Table 1: Descriptive statistics

	N	Mean	Std. Dev.	Min	Max
Female	4025	0.520	0.500	0	1
Age in VO3	4025	15.048	0.477	12.5	17.2
Social ethnic background (SES)	3873	4.071	1.642	1	6
Both parents are Dutch	4025	0.762	0.426	0	1
Education level father	3693	2.849	0.905	1	4
Education level mother	3831	2.801	0.895	1	4
Student needs extra guidance	3601	0.206	0.405	0	1
Number of students in class	4025	22.185	6.755	10	54
Test scores in grade 8					
Cito Maths	2625	43.720	10.566	5	60
Cito Dutch	2623	74.156	13.076	3	100
Rank in grade 8					
Cito Maths rank	2625	0.551	0.291	0	1
Cito Dutch rank	2623	0.555	0.291	0	1
Performance Secondary school					
Maths score	3623	64.864	19.540	7.4	99.2
Dutch score	3244	72.233	16.272	5.4	98.2

Notes: This table shows the descriptive statistics. The primary school final test of Math had a maximum score of 60 and that of Dutch a maximum score of 100. For secondary school tests a score between 0 and 100 is given.

Zumbuehl (2020) states that the intention of the COOL study was to create a representative sample of the Dutch student population. However, additional children from disadvantaged groups were added to the data to examine this group in more detail. This was only done for primary school and not for secondary school data collection, such that secondary schools more often had historically advantaged students (e.g., higher parent education, higher household income). Her (2020) report shows that students from lower socio-economic status and with lower test scores were less likely to be matched with the CBS data. Also, students that repeated or skipped a grade were more often not followed in the next wave. This implies that the sample is not entirely representative for the Dutch student population and that data has more high performing students. This is also confirmed with the average ordinal ranks that are slightly higher than expected. Therefore, the results should be interpreted with some caution with regards to drawing conclusions about the entire student population.

To further examine the data, we look at the correlation between variables. Table 2 shows that most of the variables do not have a high correlation. However, for social ethnic status and the education level of father and mother it is high. To avoid multicollinearity, we chose to control only the ethnic status, which categorizes students based on the education level of their parents combined with if their parents are Dutch or not. Excluding control variables for the education level of parents is an adjustment compared to the paper of van de Ven (2019).

Table 2: Matrix of correlations

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
(1) Gender	1.000										
(2) Age on 1-4	-0.039	1.000									
(3) socio ethnic status	-0.016	-0.223	1.000								
(4) both parents Dutch	0.012	-0.160	0.435	1.000							
(5) education father	0.010	-0.212	0.810	0.325	1.000						
(6) education mother	-0.019	-0.225	0.798	0.409	0.558	1.000					
(7) Extra guidance student	-0.062	0.176	-0.174	-0.028	-0.130	-0.169	1.000				
(8) Final Cito grade Math	-0.162	-0.200	0.222	0.013	0.189	0.206	-0.263	1.000			
(9) Final Cito grade Dutch	0.159	-0.187	0.209	0.029	0.212	0.189	-0.301	0.573	1.000		
(10) Year 3 grade Math	-0.060	-0.268	0.361	0.172	0.315	0.340	-0.332	0.642	0.518	1.000	
(11) Year 3 grade Dutch	0.205	-0.245	0.276	0.104	0.259	0.239	-0.316	0.404	0.554	0.617	1.000

Note: obs=1,718

4. Methodology

Now it is discussed which model we use to analyze the data and which variables we control for to examine the effect of ordinal rank.

Ordinal rank will be the variable of interest and academic performance will be the outcome variable of the regression. To examine the effect, a regression based on the papers of Elsner and Isphording (2017) and Denning et al. (2021) will be used. The regression looks as follows:

$$Y_{ijsc} = \alpha + \gamma r_{ijsc} + \sum_{D=1}^{4} \sum_{a=1, a\neq 5}^{10} \mathrm{I}_n \left(a_{ijsc} = a\right) \mathrm{I}_d (d_c = D) \mu_{nd} + \beta X_i + \lambda_c + \varepsilon_{ijsc} \quad (2)$$

Like the example of Elsner and Isphording (2017), the outcome variable Y_{ijsc} is an indicator of educational attainment of student i in subject j, school s and class c. For this the third-year secondary school grades of Dutch and Mathematics exams are used. The variable of interest is r_{ijsc}, which stands for the student's ordinal rank in their primary school class for a certain subject. We therefore we run two separate regressions for Mathematics and Dutch.

Then we have control variables to overcome omitted variable bias. a_{ijsc} stands for the absolute ability of the student. To control for this, we use the scores of the grade 8 final Cito exam of Math and Dutch. In our main specification we will be using a flexible form of student achievement. In this way we can model more complex relationships of ability on performance and avoid specification error. This choice is later supported when we examine the most appropriate functional form.

Denning et al. (2021) discuss that it is possible that a student's rank is influenced by the heterogeneous effect of classroom distribution by ability. For example, a person with average ability would not be influenced by a higher classroom variance, while for a top performing student, a higher variance would be expected to decrease the student's rank.

To account for this classroom distribution characteristics are interacted with the ability of a student such that we compare students from similar classrooms. Having this term in the regression also accounts for passive sorting, in which parents put their kid on a school based on certain characteristics, which could cause omitted variable bias. Since our sample size is limited, we control for this less extensively than their (2021) example. In our regression, $\mathrm{I}_n(a_{ijsc} = a)$ stands for an indicator function for the decile of the ability of a student which is measured by test score. We then interact these deciles with an indicator of distribution characteristics d_c, which is based on if the mean and variance ability are above or below the median. This gives us 4 distribution groups D. This leads us to having deciles of achievement in our regressions which can vary by characteristics of class distribution.

Furthermore, we have X_i, which is a vector for the student's characteristics, including age, gender, socio-ethnic status and if the student needs extra guidance. λ_c stands for the classroom fixed effects and ε_{isc} stands for the error term. Standard errors will be clustered on secondary school level. To make a valid comparison we use Cito final exam results which are standardized tests which are comparable across cohorts and classes.

After estimating the coefficients, this paper will examine if coefficient γ is statistically significant. The expectation is that ordinal rank has a positive effect on educational outcome. If this is found with the analysis, this shows a positive relationship between ordinal rank and educational outcome. This suggests that primary school ordinal rank of Dutch students does affect educational attainments.

5. Results

This section presents the findings of our analysis. After presenting the findings, the robustness of our analysis is tested and possible mechanisms for our results are investigated.

The main models will be run with deciles of the baseline grades of the student. As later shown when examining the functional form, this approach is most likely to model the relationship of previous achievement and the secondary school performance correctly. The regressions also include variables for if the classroom mean and variance achievement are above median to compare classes with a similar distribution. This term will be interacted with the flexible baseline achievement term.

5.1 Baseline results

To examine what the effect of ordinal rank in grade 8 is on the results in the third year of secondary school, the subjects Dutch and Mathematics are analyzed. For this we first calculate the ordinal rank based on the final Cito exams. Later, the Mid-grade 8 are used as a sensitivity analysis.

We use four regression models to measure the effect of ordinal rank in the 8th grade on performances at the third class of secondary school. First, we examine the effects on Mathematics scores presented in Table 3. Column 1 shows the impact of rank when only controlling for absolute ability. Column 2 adds additional demographics as control variables. Column 3 shows the coefficient with only fixed effects and the 4th Column is the most extensive with controls for demographics and fixed effects added. All regressions show a positive significant effect of ordinal rank on secondary school Math performance. The most extensive model shows that that an increase in ordinal rank from bottom position to top position increases the score with 10.22 points on average, ceteris paribus. This increase is significant at 5% significance level. With standardized coefficients we see that a one standard deviation increase causes a change of 0.155 standard deviations in Math score.
The results also suggest that being classified as a student in need of extra care in grade 8 impacts the secondary school Math results. Furthermore, we see that age and social ethnic status have significant coefficients.

Table 3: Regression results for Maths final Cito

	Math grades third class secondary school			
	(1)	(2)	(3)	(4)
Ordinal rank Cito	10.690***	11.79***	13.23***	10.220**
	(3.203)	(3.462)	(4.397)	(4.503)
Test score grade 8	Decile	Decile	Decile	Decile
Female		0.727		0.176
		(0.680)		(0.760)
Age		-2.222***		-1.940***
		(0.649)		(0.689)
SES				
Max. LBO & Dutch		4.344***		0.501
		(1.099)		(1.381)
Max. MBO & non-Dutch		5.866***		4.623**
		(1.593)		(1.910)
Max. MBO & Dutch		7.056***		2.620*
		(1.047)		(1.481)
Max. HBO/WO & non-Dutch		5.871***		2.085
		(1.936)		(2.176)
Max. HBO/WO & Dutch		10.260***		4.371***
		(1.161)		(1.432)
Extra guidance student		-3.850***		-4.050***
		(0.971)		(1.156)
Ability Interacted with distribution	YES	YES	YES	YES
Classroom fixed effects	NO	NO	YES	YES
Observations	2391	2125	2308	2046
Overall R^2	0.528	0.556	0.672	0.688
Adjusted R^2	0.520	0.546	0.606	0.620

Notes: This table shows the regression results of ordinal rank for Math. All control variables are added. The reference category of Socio-ethnic status (SES) is max. LBO & Dutch. Standard errors are clustered at secondary school level. Robust standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

The results for Dutch can be seen in Table 4. Here we also find a positive coefficient for all 4 regressions. Our most extensive regression shows an increase of 6.14 points, which is equal to a change of 0.111 standard deviations in Dutch score caused by a one standard deviation increase in rank. However, this coefficient is not statistically significant at 5%. This shows that there is not enough statistical evidence to state that a higher ordinal rank at the end of primary school does affect the Dutch grades in the third class of secondary school.

We once again observe that students that need extra guidance seem to score lower in the third class for Dutch. Furthermore, we now see that females tend to do better than males. Age also has a significant coefficient.

Table 4: Regression results for Dutch final Cito

	Dutch grades third class secondary school			
	(1)	(2)	(3)	(4)
Ordinal rank Cito	7.781***	6.759**	10.43***	6.141
	(2.862)	(2.723)	(3.949)	(4.163)
Test score grade 8	Decile	Decile	Decile	Decile
Female		4.073***		4.143***
		(0.723)		(0.807)
Age		-2.989***		-2.609***
		(0.631)		(0.832)
SES				
Max. LBO & Dutch		-0.752		-0.302
		(1.456)		(1.783)
Max. MBO & non-Dutch		0.779		-1.025
		(1.480)		(1.524)
Max. MBO & Dutch		0.621		0.096
		(1.211)		(1.390)
Max. HBO/WO & non-Dutch		5.098**		2.778
		(2.416)		(2.426)
Max. HBO/WO & Dutch		2.060		1.492
		(1.289)		(1.447)
Extra guidance student		-3.016***		-2.933***
		(0.837)		(0.901)
Ability Interacted with distribution	YES	YES	YES	YES
Classroom fixed effects	NO	NO	YES	YES
Observations	2134	1902	2055	1828
Overall R^2	0.399	0.433	0.537	0.567
Adjusted R^2	0.388	0.418	0.442	0.471

Notes: Notes: This table shows the regression results of ordinal rank for Dutch. All control variables are added. The reference category of Socio-ethnic status (SES) is max. LBO & Dutch. Standard errors are clustered at secondary school level. Robust standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

5.2 Heterogeneity in rank effects

Afterwards we examine the possibility of heterogeneity of rank effects in our sample.

If we find heterogeneity that would mean that by redistributing students, one could create a net gain in performance. As an increase in performance for one student could then lead to the lower decrease in performance for another student, since the effect is dependent of which rank the student had. When we take the decile of rank, however, we find that none of the quantiles significantly differ from the 5th decile. Therefore, we do not find any evidence for differences in effect of ordinal rank between quantiles. Since this heterogeneity is a criterion to creating a net gain by redistributing students, we conclude that based on the analysis this is not optimal. Figure 2 graphically shows the results. The corresponding regression results are reported in Appendix Table A1.

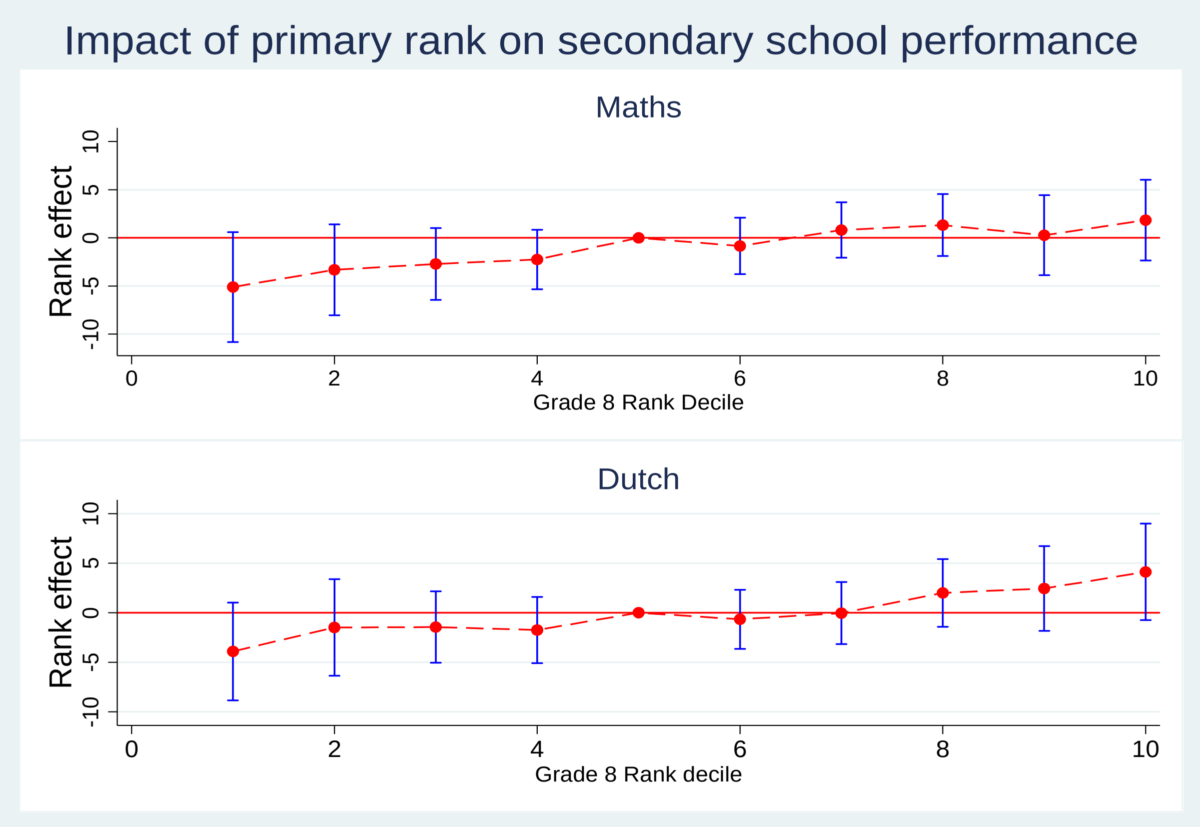

Figure 2: Heterogeneity in ordinal rank effects for Math and Dutch

Notes: This figure shows the results of the effect of deciles of ordinal rank on secondary school grades. The reference category is the fifth decile. Apart from the ordinal rank deciles, the regressions are the same as our main regressions in Table 3 and 4. The 95% confidence interval is depicted in blue.

We also look at gender differences in rank effects. Murphy and Weinhardt (2020) found that boys tend to be affected more by their rank, while Denning et al. (2021) found no differences in effect for boys and girls. When looking at differences in treatment effect for boys and girls in our setting, we find no significant interaction of ordinal rank and gender. This implies that there is no difference in how rank affects boys and girls. The results are shown in Table 5.

Table 5: Regression results for gender differences

	Grade Maths	Grade Dutch
Ordinal rank	10.682**	7.550*
	(4.587)	(4.397)
Female x ordinal rank	-0.801	-3.150
	(1.977)	(2.236)
Test score grade 8	Decile	Decile
Ability Interacted with distribution	YES	YES
Controls	YES	YES
Classroom fixed effects	YES	YES
Observations	2046	1828
Overall R^2	0.688	0.568

Notes: This table shows the regression results of ordinal rank for in terms of points on the exam. Standard errors are clustered at secondary school level. Robust standard errors in parentheses.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

As mentioned before, In Dutch primary education there are schools that chose to combine classes from different years. We interact this with the ordinal rank coefficient to examine if this makes any difference in the effect on secondary school results. As shown in Appendix Table A2, there is no significant effect found, suggesting that having a combined class does not affect the rank effects on secondary school scores for Dutch and Maths. This matches with earlier research (Kennisrotonde, 2019) that also show no difference in learning performance for these subjects between schools with and without combined classes.

Finally, following the example of Denning et al. (2021), we test for heterogeneous effects for so called historically disadvantaged groups. In our case, we look at if students in need of extra guidance and if this group is differently impacted by rank.

Our results do not show any statistically significant differences in rank effects for these students. This suggest that the rank effects are not different among these groups. The corresponding regression can be seen in Appendix Table A3.

5.3 Robustness

After running these regressions, we do additional analysis to check for the reliability and robustness of our findings.

The first important thing to consider is the functional form of our achievement variable. We look at the functional form of the previous grade to see how it relates to secondary school results. Based on the regression results for Math and Dutch in Table 6 and 7 we see that the effect of ordinal rank is not robust to functional form. Based on these findings we choose to flexibly control for student achievement as this is more likely to model the relationship correctly. Therefore, 9 indicators are added for all but the 5th decile of student achievement. Denning et al. (2021) also chose a flexible specification with quantiles of achievement for their main analysis.

Table 6: Regression results for functional form Math

	Math grades third class secondary school				
	(1)	(2)	(3)	(4)	(5)
Ordinal rank Cito Math	7.585**	2.195	2.563	2.426	9.100***
	(2.625)	(3.792)	(3.777)	(3.749)	(3.446)
Degree of polynomial	Linear	Quadratic	Cubic	Quartic	Decile
Ability Interacted with distribution	NO	NO	NO	NO	NO
Controls	YES	YES	YES	YES	YES
Classroom fixed effects	YES	YES	YES	YES	YES
Observations	2046	2046	2046	2046	2046
Overall R^2	0.680	0.682	0.682	0.682	0.680
Adjusted R^2	0.619	0.620	0.621	0.621	0.617

Notes: This table shows the results for Math with various functional forms of student achievement. Standard errors are clustered at secondary school level. Robust standard errors in parentheses.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 7: Regression results for functional form Dutch

	Dutch grades in third class of secondary school				
	(1)	(2)	(3)	(4)	(5)
Ordinal rank Cito Dutch	11.080***	2.938	1.834	2.933	5.753
	(4.093)	(3.977)	(4.113)	(4.192)	(3.597)
Degree of polynomial	Linear	Quadratic	Cubic	Quartic	Decile
Ability Interacted with distribution	NO	NO	NO	NO	NO
Controls	YES	YES	YES	YES	YES
Classroom fixed effects	YES	YES	YES	YES	YES
Observations	1828	1828	1828	1828	1828
Overall R^2	0.555	0.560	0.560	0.561	0.562
Adjusted R^2	0.469	0.474	0.475	0.475	0.475

Notes: This table shows the regression results for Dutch with various functional forms of student achievement. Standard errors are clustered at secondary school level. Robust standard errors in parentheses.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

One other important concern is that the effect found could be driven by the secondary school one attend. This is even more relevant in the Dutch school system in which there is relatively high heterogeneity in the secondary education system in terms of level and ways of teaching. However, as Murphy and Weinhardt (2020) argue, the secondary school characteristics can also be seen as an outcome of the ordinal rank in primary school. To examine if secondary school drives the effect, we run a regression in which we add secondary school fixed effects to see how it changes our findings. One must be careful with the interpretation of this coefficient as it is a possible mechanism.

As Table 8 shows, adding secondary school fixed effects, decreases the effect with 0.7 points, however the effect found is still significant for Math. Alternatively, we control for advice received by a student. Advice is correlated with ordinal rank; however, it does not directly impact the secondary school performance. When controlling for advice we see results which are like those of our main regression, in which ordinal rank increases the Math grade with 10.2 points. For Dutch the effect is still not statistically significant. This suggests that our findings are not just driven by the secondary school a student attends.

Table 8: Regression results with control for secondary school and advice

	Secondary school fixed effects		Advice control	
	Math	Dutch	Math	Dutch
Ordinal rank Cito Math	9.524**	7.374*	10.281**	3.891
	(4.400)	(4.153)	(4.655)	(4.093)
Test score grade 8	Decile	Decile	Decile	Decile
Ability Interacted with distribution	YES	YES	YES	YES
Controls	YES	YES	YES	YES
Classroom fixed effects	YES	YES	YES	YES
Observations	2035	1820	1969	1752
Overall R^2	0.729	0.614	0.695	0.588

Notes: This table shows the regression results of our main regression with an added term to control for the secondary school the student attended. For the advice control, advice was divided into VMBO, HAVO and VWO and if there was a combined advice, students were included in the lowest education group. Standard errors are clustered at secondary school level. Robust standard errors in parentheses.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

5.4 Sensitivity analysis

Now, we will run some sensitivity analysis to see if our results hold if we make slight changes in our regression.

5.4.1 Low-stake test

First, we look at the effect of ordinal rank based on mid-grade 8 tests. As the final Cito test shows how well a student did their Cito test and could have some measurement error (for example, the student was feeling sick). We use another test made in this academic year to control if the final Cito is indeed a reliable representation of a student's ability. Arguably, this test can be seen as low stake as it plays a smaller role in the primary school advice a student gets.

For Mathematics we take a previous Math score. For Dutch however, the Cito final exam consisted of multiple components. To make a valid comparison between the mid-grade 8 Dutch score and the final Cito exam we take two of the components which we have mid-grade 8 test data on and weight them according to the weights in the Cito end exam grading. From a report on the Cito score computation of 2011 (van Thil et al., 2012), we find that from 100 questions on Dutch, 30 were on reading comprehension (Begrijpend lezen) and 20 on vocabulary (Woordenschat). With this we create a weighted ordinal rank which should represent a proxy of (a part of) the Dutch ordinal rank.

Table 9 shows the results of the regressions based with the low stake test ordinal ranks. When we use our most extensive model and calculate ordinal rank based on the Cito mid-grade 8 Math exam, the regression shows that there is still a significant result of ordinal rank on the third-class Math score. The effect shows to be two times higher than of the end test of Cito.

For Dutch we find a similar coefficient to the main analysis, but this time it is statistically significant at a 5% level. This suggest that the effect of ordinal rank on secondary school scores has the same signs for the mid-grade 8 and end-grade 8 score and lower and higher staked test. However, we do find a higher effect for Math and a similar effect for Dutch compared to the end exam of Cito.

Table 9: Regression results for Low stake tests

	Grade Math	Grade Dutch
Ordinal rank low stake tests	19.964***	5.906**
	(2.196)	(2.279)
Test score grade 8	Decile	Decile
Ability Interacted with distribution	YES	YES
Controls	YES	YES
Classroom fixed effects	YES	YES
Observations	1919	1295
Overall R^2	0.705	0.591

Notes: This table shows the regression results of ordinal rank of the mid-grade 8 exams on the secondary school exam. Standard errors are clustered at secondary school level. Robust standard errors in parentheses.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

In some classrooms a few students made another test than their peers. Because some scores of test versions are not directly comparable, we also run a regression with the low stake test in which we drop the observations of the student that made the exam that the minority of the class made. Not doing this would give a possibly false representation of the student's ability as the student only gets a rank compared to others that made the same test. However, we observe that dropping the observations minimally changes the coefficients, as shown in Appendix Table A4.

5.4.2 Measurement error

Additionally, we also control for some measurement errors in our main analysis. the corresponding tables can be found in Appendix A5 and A6.

First, we run a regression in which we drop observations with missing answers in more than 50% of the third-year exams. As the COOL researchers (Zijsling et al., 2014) mention, this could be a sign of the student putting low effort into the exam. Since missing answers are seen as wrong, this could give a biased representation of the student's educational outcome. Excluding these observations give slightly higher coefficients for the effect of ordinal rank for Math and Dutch. However, the significance and sign stay the same for both subjects.

Second, we look at the age of our sample. Because the age of most students of class 3 is expected to be between 14.5 and 15.5 we run a regression in which we only include this group. This is expected to exclude students which repeated or skipped a grade during their educational career. Excluding these students minimally changes our findings.

5.5 Mechanisms

Looking into mechanisms we test five possible mechanisms. The results can be seen in Table 10.

First, we test self-efficacy. Reed et al. (2015) describe this as: "how confident students are that they will be able to master their schoolwork". They discuss that self-efficacy of students can be influenced by the achievements of their peers. For example, observing someone who is perceived to have a lower rank successfully completing a task, might give a student more confidence in also completing it. Honcick and Broadbent (2016) also find that academic self-efficacy is related to performance.

In the survey that was distributed to participants of the COOL research, students were asked to rate 6 different questions about their self-efficacy. Based on this, students were given a score for self-efficacy. When including this variable in the most extensive model, we find no significant effect of self-efficacy on test scores. This is contrary to findings of van de Ven (2019) and Murphy and Weinhardt (2020), who did find an effect.

Secondly, we look at work attitude. An experiment of Papadopoulos et al. (2015) find that students change their behaviour when receiving information on their ranking. Their data suggests that higher ranking students tend to put more effort in and perform better. Van de Ven (2019) also found work attitude to be a mechanism. When running a regression, we do find a positive effect of ordinal rank in grade 8 on work attitude, but it is not significant at 5% significance level. This means that we do not find work attitude to be a mechanism in our sample.

Murhpy and Weindhardt (2020) tested for parental investment and argued that it was unlikely to be one of the mechanisms in the effect of ordinal rank on educational performance, as it is unlikely for parents to have full knowledge of their child's rank per subject. Elsner and Isphording (2017) did also not find any statistical evidence for this. Nevertheless, it is possible that in the Dutch setting, parents react to the rank of their children, for example, because they might expect higher returns in their performance. From the third column of Table 10 we see that in our sample, the coefficient of parent involvement is statistically significant, which implies that, on average, parents have higher involvement when the ordinal rank of their child is higher.

We then look at the competitiveness of student as a mechanism. Murphy and Weinhardt (2020) describe how this mechanism could work. It is possible that students with a higher rank get more competitive when they are in an environment with new students and therefore put more effort to have higher test scores. They might also be more aware of their rank. In the COOL research, children were asked to report questions related to their competitiveness. Our regression shows that competition has no significant relationship with rank, which indicates that competitiveness is not a mediator of the effect of ordinal rank.

We also observe the attendance in class. This factor can be seen as an indicator of the motivation of a student. Attendance has also shown to increase the performances of students (Dobkin et al. 2010). It is possible that students with a lower ordinal rank lose motivation and therefore attend less classes which leads to lower grades. However, Fryer et al. (2017) argue that lower perceived ability could also increase a student's attendance. Students that believe that they have a lower ability might attend more classes to increase their ability and therefore get higher results. The results show a negative relation between ordinal rank and number of classes skipped, which is not statistically significant. Therefore, there is not enough evidence that class attendance mediates the effect of ordinal rank on secondary school performance.

Table 10: Regression results for Mechanisms

	Self-efficacy	Work Attitude	Parental Involvement	Competition	Skipping class
Ordinal rank Cito	-0.377	0.349	0.902***	0.017	-0.365
	(0.257)	(0.255)	(0.263)	(0.426)	(0.352)
Test score grade 8	Decile	Decile	Decile	Decile	Decile
Ability Interacted with distribution	YES	YES	YES	YES	YES
Controls	YES	YES	YES	YES	YES
Classroom fixed effects	YES	YES	YES	YES	YES
Observations	1714	2242	1545	1683	1313
Overall R^2	0.261	0.516	0.518	0.272	0.262

Notes: This table shows the regression results of ordinal rank on possible mechanisms. Standard errors are clustered at secondary school level. Robust standard errors in parentheses.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

6. Discussion

This research examined the effect of ordinal rank in the last class of primary school on the educational performance in the third class of secondary school for Dutch students. For Mathematics, a one standard deviation increase in rank leads to a grade of 0.155 standard deviations higher in secondary school. This increase is almost two times that of Murphy and Weinhardt (2020) that found 0.08 standard deviation increase. However, it is lower than van de Ven (2019), that found an increase of 0.226 standard deviations for Math grades in primary school.

For Dutch, no significant effect is found of ordinal rank on the third-class grades in our main regression. Our results suggest that contrary to the findings of van de Ven (2019), the ordinal rank in Math is more important than that of Dutch in this setting.

When we compute ordinal rank based on mid-grade 8 tests, we find significant effects of ordinal rank. Compared to the final Cito exams, the magnitude of the effect of Math is higher, and the rank effect of Dutch is significant. Since the ordinal rank variable is computed by the number of students in the classroom (which stays constant) and the rank, this difference must come from the differences in rank of both exams. For Dutch, we know that our proxy is not fully representative for the final Cito exam, since we could only include two out of four parts when making this proxy. Furthermore, it is indeed the case that circumstances of this mid-grade 8 test are slightly different from the final Cito exam, as the final Cito is made in three days and is externally graded. With the mid-grade 8 exams, the regulations are less strict, and schools have more freedom to choose when they do the exam. Besides that, it is possible that students react differently when the stakes of the exam are higher. Therefore, one would expect that the pressure to perform is the highest for this exam. These factors could lead to a different rank of students which could explain the different findings.

The results of this paper do not seem to be robust to the functional form of previous grades. When testing for functional form only the linear and flexible form of these grades show a significant effect of ordinal rank. A possible explanation for not finding robustness could be due to our sample size, which is smaller than previous papers.

The results showed to be robust to dropping tests with a high amount of missing answers and reducing the sample to students within the usual age range of students in the third class of secondary school. Furthermore, we see no differences in how ordinal rank impacts males and females. We also do not find evidence for heterogeneity for students that need extra guidance. We do observe that females tend to score higher in Dutch than males. This corresponds with earlier research of Driessen and van Langen (2013) on differences between boys and girls in education. Besides this, the results show that being an student that needs extra guidance significantly relates to a decrease in the secondary school performance. This newly introduced variable is important to consider in future research, as not doing so might lead to a biased estimator.

We also tested for the possibility of combined classes to influence the effect of ordinal rank. It could be possible that students in combined classes have a different perception of their ranking their class because they are surrounded with student from a different year. Our results show that combined classes do not show different effects of ordinal rank. This relates to literature (Kennisrotonde, 2019) that shows that students in combined classes do not significantly differ in performances compared to students of 'non-combined' classes.

Looking at mechanisms we found that children with higher ordinal rank tend have higher parental involvement. We did not find evidence for other mechanisms suggested by other studies, such as, self-efficacy, work attitude, competitiveness and skipping classes.

This paper is comparable to the paper of Murphy and Weinhardt (2020). They also look at the ordinal rank at primary school and how this effects grades on secondary school. Although there is some overlap, there are also some important differences. In both countries primary school start at age 5, but in the Dutch system students end at the age of 12. After this, children go to different streams of secondary schools with different academic level and different study period. In this system there are 2 main tests. One of them being the Cito at the end of primary school which decides your secondary school. And the second at the end of secondary school which decides if you can obtain your secondary school diploma. In England it is slightly different. Their school system exists of 4 key stages, such that each key stage ends with a national exam. The students tend to specialize later than in the Netherlands, which causes a difference in setting. The age at which students make a national test in the setting of this paper and that of Murphy and Weinhardt (2020) are similar. In the Netherlands it is age 11/12 and in England it is age 10/11. However, the stakes are different as the Dutch secondary school enrollment depends on the grades of their exam. However, for the secondary school exams (our outcome variable) the stakes are higher for the English students. Also, the Dutch students would have had more heterogenous teachings at secondary school level, as they were divided based on their ability in primary school and go to secondary schools of different levels.

It is also important to note that the final Cito exam has gotten a different role over the years. Our last cohort did their Cito in 2011, but since 2015 all schools were mandated to have a final exam in 8th grade. From that year schools could choose from several final exam types to measure the levels of Dutch and Mathematics of these grade 8 students. Instead of the final Cito exam, the school advice has become leading in the secondary school one could attend and the exam period shifted from February to April/May of the academic year. The final exam changed to a medium which could make teachers to review their advice, however the advice could only be increased and not decreased, based on the test score (Lek, 2020).

Although the Cito final exam has lost some of its relevance in the past years and has there are now several final primary school exams to choose from. it could still indicate students' ability and ordinal rank. As Denning et al. (2021) describe, the ordinal rank can be seen as a proxy for how students daily rank in their classroom. This rank is expected to become known by students, teachers, and parents through repeated contact in primary school. This means that other measures of ability should also be able to indicate the rank of a student. However, since this research showed that there could be a difference in rank, depending on if one uses low stake or high-stake test, it would be helpful to have repeated measure of students' performances over time to compute the ordinal rank. An additional advantage would be that this repeated measure is where the school advice is partly based on.

When talking about the applicability of these results, Denning et al. (2021) rightly mention that changing classroom distributions based on findings on ordinal rank will have equilibrium effects. Since this paper mainly focusses on ordinal rank, it can lead to problems when creating classrooms based on only these findings. With the absence of evidence that there is heterogeneity in the effect of rank in this research, the possibility to increase the aggregate effect of rank is also eliminated. However, this research adds to literature by showing that ordinal rank effects also exist in the Dutch education system and works even during secondary school. It also confirms that ordinal rank is indeed something to account for when discussing peer effects or thinking about how to organize classrooms in the Dutch school system. Failing to do so could cause serious bias as showed by Bertoni and Nisticò (2019).

Having high ability peers might increase performance due to peer effects, but this paper shows additional evidence that it also decreases performance by drops in ordinal rank. We also see that the findings in this paper show some differences in effect compared to other papers on ordinal rank. For example, van de Ven (2019) found for primary schools in the Netherlands that ordinal rank in grade 2 influenced performance in grade 8. Here she found no difference in effect for low and high-stake tests for Dutch and Math. This research shows, however, that there is a difference between low and high-stake test and the ordinal rank effect is only applies to Math. This shows that in the Dutch context, there is already differences in effects found when looking at different periods in the education system. Also compared to Murphy and Weinhardt (2020) we see that even though the settings have similarities, the magnitude of our effect is twice as large. This confirms the importance of being cautious of applying findings to other settings in research on educational performance.

Like other papers (e.g., Murphy and Weinhardt, 2020; Denning et al., 2021) discuss, these findings also add to the discussion on attending selective schools. Research is not sure on if this improves performance and ordinal rank can be one of the explanations for this.

One should also keep in mind that the sample size of this research is smaller than some other papers on ordinal rank (e.g., Murphy & Weinhardt, 2020; Denning et al., 2021). As far as is known, the COOL dataset is the only publicly available dataset on primary and Dutch secondary school students. Nevertheless, an advantage of this dataset is that contrary to other papers[6], we do observe classrooms in which students are taught. We can therefore more precisely control for this to make sure there is no confounding effect.

This research is a first attempt in examining the effect of rank in primary school on secondary school performance. Because of the relatively small number of students that were followed after the third class of secondary school, it is hard to make estimations on longer term effect. This is something that could be done in future research. There might be some new challenges with analyzing these long-term rank effects in the Netherlands as the heterogeneity in secondary education only grows after the third class. This is because on HAVO and VWO, students will start specializing in certain subjects and VMBO will also make the transition to the MBO. This might make it harder to compare the student performances, although we saw papers (e.g., Denning et al., 2021) that looked at income, which would be comparable long-term result. It would also be interesting to use average grades as an indication of student's achievement, as they might give a more robust representation of a student's rank in the class. This would reduce the chances of measurement error as having bad days are expected to be "averaged out". Furthermore, it would also be more congruent with the idea of student ranking in test grades being a representation of their day-to-day ranking.

[6] Elsner & Isphording (2017), Murphy and Weinhardt (2020) and Denning et al. (2021) all only knew the cohort the student was in.

7. Conclusion

The aim of this paper was to examine the effect of ordinal rank in the last grade of primary school on the secondary school performance of Dutch students. We did find that a higher ordinal rank in Math causes a higher Math performance in the third class of secondary school. We do not find enough evidence for an effect of Dutch rank on performance. The magnitude of the effect of Math is relatively high when comparing it to other effect sizes in literature on the improvement of educational performance.

We found evidence for parental investment to be a mechanism that drives the effect of ordinal rank. However, we did not find heterogeneity in the effect of rank. This implies that the possibility to generate a net gain by redistributing students is excluded.

Looking at the limited sample size and number of cohorts in this research. Future research could focus on a larger sample size in which we can better measure and model heterogeneous relationships. Furthermore, it might be interesting to look at long term effects in the Dutch school system. Since Dutch students are tracked early, it is likely that the effect of rank is different than that of other countries. A challenge in doing this is finding an outcome variable that is comparable across all educational pathways in the Netherlands. A suggested solution is to look at income, following the example of other papers on academic rank.

Our findings suggest that In the Dutch education system it is also important to account for the effect of rank on performance. It is shown that primary school rank even effects performance when students are redistributed to a new class with a new set of peers. Therefore, literature on peer effects and classroom design should consider the effect of rank, to prevent biases in their estimations. Furthermore, this paper shows the importance of controlling for students that need extra guidance, as these students seem to have lower grades.

In practice it is unlikely that students will be redistributed based on these findings on rank effect. It would even cause issues because of equilibrium effects, which arise due to all other factors that could influence student performances. Nevertheless, it is important to know that rank effects do exist in the Dutch education system, and it has a relatively large effect on the educational performance of students.

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Appendix

Table A1: Regression results of heterogeneous effects of ordinal rank

	Grade Maths	Grade Dutch
1st rank decile	-5.115*	-3.905
	(2.893)	(2.495)
2nd rank decile	-3.323	-1.489
	(2.392)	(2.459)
3rd rank decile	-2.714	-1.453
	(1.892)	(1.823)
4th rank decile	-2.251	-1.752
	(1.566)	(1.687)
5th rank decile	0	0
6th rank decile	-0.846	-0.663
	(1.487)	(1.508)
7th rank decile	0.811	-0.048
	(1.454)	(1.586)
8th rank decile	1.325	1.998
	(1.625)	(1.727)
9th rank decile	0.267	2.442
	(2.106)	(2.161)
10th rank decile	1.837	4.114*
	(2.123)	(2.461)
Test score grade 8	Decile	Decile
Ability Interacted with distribution	YES	YES
Controls	YES	YES
Classroom fixed effects	YES	YES
Observations	2046	1828
Overall R^2	0.688	0.568

Notes: This table shows the results of deciles of ordinal rank on secondary school grades. The reference category is the fifth decile. Standard errors are clustered at secondary school level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table A2: Regression results for heterogeneity shared classes

	Grade Maths	Grade Dutch
Ordinal rank	10.625**	6.512
	(4.542)	(4.099)
Shared class x ordinal rank	-5.425	-8.894
	(5.190)	(7.372)
Test score grade 8	Decile	Decile
Ability Interacted with distribution	YES	YES
Controls	YES	YES
Classroom fixed effects	YES	YES
Observations	2046	1828
Overall R^2	0.688	0.568

Notes: This table shows the regression results of our main regression with an added interaction term to check differences in effect for shared classrooms. Standard errors are clustered at secondary school level. Robust standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table A3: Regression results for heterogeneity extra guidance student

	Grade Maths	Grade Dutch
Ordinal rank	9.763**	4.568
	(4.557)	(4.119)
Extra guidance student x	1.506	5.241
Ordinal rank	(2.795)	(3.354)
Test score grade 8	Decile	Decile
Ability Interacted with distribution	YES	YES
Controls	YES	YES
Classroom fixed effects	YES	YES
Observations	2046	1828
Overall R^2	0.688	0.568

Notes: This table shows the regression results of our main regression with an added interaction term to check differences in effect for students in need of extra guidance. Standard errors are clustered at secondary school level. Robust standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table A4: Regression results of Low-stake test excluding minority test

	Grade Maths	Grade Dutch
Ordinal rank low stake tests	20.217***	5.808**
	(2.266)	(2.381)
Test score grade 8	Decile	Decile
Ability Interacted with distribution	YES	YES
Controls	YES	YES
Classroom fixed effects	YES	YES
Observations	1867	1295
Overall R^2	0.715	0.597

Notes: This table shows the regression results of ordinal rank of the mid-grade 8 exams on the secondary school exam, excluding the test the minority of the students made. Standard errors are clustered at secondary school level. Robust standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table A5: Regression results excluding high % of missing answers

	Grade Maths	Grade Dutch
Ordinal rank	11.012***	6.562
	(4.483)	(4.145)
Test score grade 8	Decile	Decile
Ability Interacted with distribution	YES	YES
Controls	YES	YES
Classroom fixed effects	YES	YES
Observations	2018	1821
Overall R^2	0.693	0.582

Notes: This table shows the regression results of our main regression, but with the exclusion of students that had missing answers for more than 50% of the questions. Standard errors are clustered at secondary school level. Robust standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table A6: Regression results excluding age outliers

	Grade Maths	Grade Dutch
Ordinal rank	9.554**	2.707
	(4.712)	(4.763)
Test score grade 8	Decile	Decile
Ability Interacted with distribution	YES	YES
Controls	YES	YES
Classroom fixed effects	YES	YES
Observations	1711	1526
Overall R^2	0.673	0.562

Notes: This table shows the regression results of our main regression, but with the exclusion of students that are outside of the age range of 14.5 and 15.5 years old. Standard errors are clustered at secondary school level. Robust standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.