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The Working Life of a Teacher: Lessons from the Danish Matched Student-Teacher Data

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The Working Life of a Teacher: Lessons from the Danish Matched Student-Teacher Data*

Abstract

This paper uses Danish register-based matched student–teacher data to characterize public school teachers and their working conditions. We document gender segregation across subjects and grades, with female teachers dominating Danish instruction and male teachers more common in upper-grade math. Teachers select into subjects based on subject-specific academic skills, yet a notable share has weak prerequisite skills. Teachers often specialize in student age groups but teach multiple subjects. Those with stronger skills tend to work in schools with similarly skilled colleagues. These findings provide new insights relevant for interpreting education research and designing policies to improve teacher retention and wellbeing.

JEL classification

I20, I28, J24

Keywords

teachers, teacher working conditions, teacher skills, teacher health

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1. Introduction

Every day, teachers provide the personal interaction and basic infrastructure key to much of children's human capital accumulation. Accordingly, a vast literature has explored the importance of teachers for student outcomes and wellbeing (Schaede and Mankki, 2022; Bacher-Hicks and Koedel, 2023), for example by estimating teacher value added (e.g. Chetty et al., 2014). Another strand of literature has sought to understand how to attract and subsequently retain good teachers (e.g. Ronfeldt et al., 2013; Podolsky et al., 2019; Toropova et al., 2021). Still, to grasp what teachers offer children, we argue that we need a more comprehensive understanding of who the teachers are, of their work schedules and their peers, and of indicators of struggles. After all, these are the characteristics and domains that policy makers can affect. This paper uses recently available data to characterize teachers and their working conditions.

At the core of our analysis are matched student-teacher data covering the primary and lower secondary levels of public schooling in Denmark (UDDLAERER, Statistics Denmark, 2024). That is, our data link teachers to classrooms across all subjects taught and contain information about the children in each classroom as well as about teaching hours. Additionally, they include individual level identifiers for both teachers and children, allowing for linkages to other administrative data sources.

Teaching is clearly a gendered profession but with some nuances (e.g. Schaede and Mankki, 2022; See et al. 2022). We find that the vast majority of teachers responsible for delivering teaching in Danish are female, although the propensity decreases somewhat with grade (91% female in grade 1 compared to 75% in grade 7). Math teachers are somewhat less likely to be female and children in higher grades are substantially more likely to meet a male math teacher (68% women in grade 1 and 43% in grade 7).

There is strong selection by skills into subject specialization; average high school grades in Danish for the group of Danish teachers are close to the mean in the overall population, whereas their average high school grades in math are about .4 standard deviations lower than the mean. For math teachers, in contrast, we find that average high school grades in Danish are .2-.3 standard deviations lower than the mean, whereas their average high school grades in math, instead, are just above the mean. Where grades of Danish teachers in written Danish are concentrated around the mean, grades of math teachers in written math are spread out with about 18 percent top performers and about 17 percent failing.

What is also true is that teachers typically interact with a substantial number of children on a regular basis. In a school year, teachers typically teach two-three classrooms with 20-25 students in each, but some teachers teach as many as seven classrooms. Not only do teachers engage with many students, but they also spend considerable time with each of their classrooms. At the lowest grades (1-3), Danish teachers, for example, spend more than 300 hours per year delivering Danish lessons to a given classroom, whereas math teachers spend about 150 hours regardless of grade. Moreover, more than half of teachers spend more than half of their time in a particular classroom. Teachers, of course, deliver teaching relevant to children's academic development but are also required to handle a variety of behavioral and social challenges. More than 30 percent of children in grade 1, for example, either have a mental health diagnosis prior to school enrollment or have at least one parent who has or has had a mental health diagnosis.

Teachers clearly navigate a multitude of social relationships, but they also cover various distinct subjects within a given school year, adding to the cognitive load. We do observe considerable subject specialization. Danish teachers, for example, often also deliver teaching within religious studies, English, and history, whereas math teachers commonly also teach science. Specialization occurs in terms of student age groups too. Moreover, at least to some extent,

teachers tend to sort into schools by their average high school grades. This implies considerable variation in the academic quality of the collegial networks at public schools. We find that the gap in the average teacher high school GPA between the top and the bottom schools is about 1.5 SD. Thus, on top of the direct effect of teacher skills on students, there is also an indirect effect going through the quality of teachers' collegial network on students (Jackson and Bruegmann, 2009).

Finally, we characterize the teachers in terms of indicators of (work-related) struggles. We find that teachers are absent from work as many as 9-13 days per year, depending on the grade level they teach to.[1] This is vastly higher than the number for the overall population: In 2018, average absence in full-time equivalents was just below 9 days (StatBank Denmark, n.d.). It is comparable to the corresponding number for other municipal employees, who stayed home for just over 13 days per year in 2018.[2] High levels of absence are expensive in terms of productivity loss because substitute teachers are not nearly as effective as the regular primary teacher (Hermann and Rockoff, 2012). Furthermore, the fraction of teachers who have faced mental health issues in the past 5 years increased significantly from 2013/14 to 2019/20 no matter whether measured by actual diagnoses or by contacts with specialists. If left unaddressed, such struggles are known to strongly affect own labor market success (Biasi et al., forthcoming). At roughly 20-25% percent, turnover rates are like those in the overall labor market (Andersen, 2023) but it is prominent that of those who leave teaching at their current workplace, only about half return to teaching at the same school later or move to another public school.

[1]We include absence due to own sickness and work-related accidents, but most of the absence is due to own sickness. Our numbers are based on the number of hours of absence reported, which are converted to man-days.
[2] The absence for the overall population and the municipal employees includes own sickness and work-related accidents.

Our paper contributes with insights about teachers and their work, relevant for proper interpretation of many research findings within the field of education. Institutional settings are often critical for the internal and external validity of empirical studies, too. Moreover, we provide information to policymakers who make decisions about the institutional arrangement and resource allocation that together shape the working-life of teachers. Lastly, in a broader sense, we offer specific and rare insights into the working life of a set of employees; information that is rarely available on this scale about any profession.

We start out by describing the institutional details in Section 2, while Section 3 presents our data. Section 4 describes the teachers and Section 5 explores aspects of their working conditions. Section 6 continues to analyze indicators of teacher struggle such as work absences, poor mental health, and turnover. Finally, Section 7 discusses and concludes.

2. Institutional details

Primary and lower secondary school in Denmark covers grades 0 through 9 and an optional grade 10.[3] Children must start school in the year they turn 6 (grade 0) and have 10 years of compulsory schooling. Schools, municipalities and the Danish ministry of education generally operate with a division of grades 0-9 into three tiers: 1) grades 0-3 ("indskoling"), 2) grades 4-6 ("mellemtrin"), and 3) grades 7-9 ("udskoling"). The practical organization of these tiers can vary substantially across schools.

Grade 0 differs from grades 1-9 in both purpose, staff characteristics, and organization. The purpose of grade 0 is to prepare students for learning and attending school in later grades and

[3] For more details see UFM (2021) and the Danish Folkeskole Act https://www.retsinformation.dk/eli/lta/2025/1100.

instruction is more playful and less academic.[4] Contrary to later grade levels, teachers in grade 0 are not typically trained at a teachers' college and they are highly specialized in teaching grade 0. Formal training for teachers teaching students in grades 1-9 consists of a postsecondary education at a university college, which is typically preceded by a high school degree. The current education program is 240 ECTS (European Credit Transfer and Accumulation System) and focuses on both teacher's didactic and pedagogical competences, subject-specific skills, and teaching practices.[5] The curriculum for grade 0 describes a set of broad competence areas (e.g. mathematical awareness, scientific phenomena, body and movement), but there are no specific subjects with minimum required teaching hours per year as those defined for grades 1-9.

In the school year 2014/15, the government implemented a major public-school reform that had three main areas of intervention: 1) longer and more varied school days, 2) upskilling of school staff, and 3) lower administrative burdens (BUVM, 2020). The reform was accompanied by changes in the agreements about teachers' working hours, which had major implications for teachers' working conditions; teachers were now required to teach more hours and to generally be physically present for more hours at the school (Drescher et al., 2016). The data we analyze includes one pre-reform school year, 2013/14, which implies that we can also look at whether key statistics have changed across the years – potentially because of the reform.

Most Danish children attend public schools, but the use of private and independent schools has been increasing over time. Overall, the share of a cohort attending either a regular or special education public school is about 80 percent (UFM, 2021).

[4] The Folkeskole Act ("Folkeskoleloven"), consolidating act ("lovbekendtgørelse") no. 989, 27/08/2024.
[5] Order ("bekendtgørelse") concerning teacher education no. 707, 11/06/2024.

3. Data

Our analyses make use of population-wide Danish register-based data. Key to our project is the matched student-teacher data, UDDLAERER (2013/14-2019/20), that covers the primary and lower secondary levels of schooling in Danish public schools (Statistics Denmark, 2024). Beyond student-teacher matches, the data set contains information about teaching hours by subject. A unique identification number (the central personal register number; CPR) allows us to link individuals, both teachers and students, across various registers.

We collect demographic information on teachers and students from the population register (BEF), the education register (UDDA), and the income register (IND). We gather information about teaching experience and teachers' absence from the integrated database for labour market research (IDA) and the absence register (FRPE). Information about teachers', children's and parents' mental health is based on the national patient register (LPR_ADM, LPR_DIAG, PYSK_ADM, PSYK_DIAG, PRIV_ADM, PRIV_DIAG, LPR_A_KONTAKTER, LPR_A_DIAGNOSE, varying coverage) and the health insurance register (SSSY, available from 2005). We obtain information about teachers' subject-specific academic skills from the high school grade register (UDGK, available from the 1997/1998 school year), about high school GPA from the completed education grade register (UDG, high school GPA available from the 1977/1978 school year) and about the grade for the bachelor's project at teacher's college from the completed education grade register (UDG, these specific grades are available from the 2003/2004 school year).

The register UDDLAERER contains information on 862,118 students in 159,535 classrooms taught by 73,911 teachers in the school years 2013/14 to 2019/20, cf. Appendix Table A1 for an overview of the sample selection criteria and the resulting sample sizes. Coverage of the data register has been assessed to be high with more than 96 percent of students in regular

classrooms and more than 99 percent of regular classrooms covered. Coverage is generally slightly lower in the first years and varies across subjects. 80 percent of students have a teacher match in all mandatory subjects. For a detailed analysis of coverage rates, see Statistics Denmark (n.d).

The matched data only includes information on students and teachers in public schools. About 80 percent of a cohort attend public schools and more children attend public schools at lower grade levels. For example, at the midpoint of our sample period, in 2016/17, 83 percent of children attended a regular public school in grade 1 compared with 82 percent in grade 4 and 78 percent in grade 7 (uddannelsesstatistik.dk).

We focus on regular classrooms in grades 0-9 where coverage of UDDLAERER is high. Consequently, we drop observations related to special classrooms, i.e., classrooms for students who need additional support. A smaller part of the observed classrooms is very small (five students or less), and we drop these from the analysis too.

In some cases, we observe two or more teachers teaching the same classroom in the same subject in the same year. We focus our attention on the primary teacher in each subject-classroom-year combination. We define the primary teacher based on two sequential criteria:

a. The teacher who taught the classroom for the largest number of hours
b. The teacher employed in a teaching position

The first criterion aims to identify the teacher who has spent the most time with the students, but the second requires some additional justification. Many schools operate with some kind of teacher's aides at least to some extent. In the data, this would result in a student having two teachers in the same subject, but where one of the teachers would be the actual teacher and the other would be the teacher's aide. The former would typically be employed in a teaching position at the school while the latter would typically have pedagogical training and be

employed in a pedagogical position. The data is not directly informative about which teacher is the primary teacher, and we therefore use the information available to us to deduce this. Focusing on the primary teachers and excluding the smallest classrooms with less than five students reduces the number of teachers in the sample but has very limited impact on the number of students and the number of classrooms in the sample. These sample restrictions result in a sample of 843,765 students in 146,337 classrooms taught by 63,351 teachers. In most of the analyses, we exclude grade 0, exactly because it is organized differently than the remaining grades in Danish public schools. In total, our main sample includes 60,857 primary teachers teaching 795,932 students covering the school years 2013/14-2019/20.

4. Who are the teachers?

Tables 1 and 2 show descriptive statistics for the subsamples of Danish (Table 1) and math (Table 2) teachers teaching grades 1, 4 and 7.[6] A Danish (math) teacher is one who we classify as a primary teacher in a classroom where he or she teaches Danish (math). The unit of observation is the classroom. Thus, a teacher may be represented in more than one column in the tables and may also be represented more than once in each column. We focus on grades 1, 4 and 7 corresponding to the first grade-level in each tier of the school abstracting from grade 0.

In terms of *personal characteristics*, one striking difference between Danish and math teachers is that while females dominate instruction in Danish, males are much better represented in math instruction; 91 percent of Danish teachers in grade 1 are female compared to only 68 percent of math teachers. For both Danish and math, the share of female teachers declines substantially

[6] Corresponding descriptive statistics for all primary teachers in grades 0, 1, 4 and 7 are shown in Appendix Table A2 where there is one observation per teacher-classroom-school year.

across grade levels meaning that students at higher grade levels are much more likely to have a male teacher in these core subjects. The average teacher is about 43 years old, cf. Table 1, 2 and Appendix Table A2. Only a small proportion of teachers – around two percent – are of non-Western origin.

To get a grasp of *teachers' academic skills*, we compute the average high school GPA, the average grades from subject-specific written exams in Danish and math in high school as well as average grades from the teachers' college. All of these are standardized within the cohort defined by year of completion of the relevant education. Unfortunately, we do not observe these measures for the entire sample since grade information is generally not available for older teachers. With this caveat in mind, we find that Danish teachers on average have better Danish skills than math teachers and vice versa. While the teachers have grades close to the average of their cohort in the subject (Danish or math) in which they teach, they have substantially lower grades than the average of their cohort in the other (Danish or math). Also, teachers at higher grade levels have better skills in the subject they teach. This may also reflect that the skill requirements for teachers are higher at higher grade levels due to an increasing complexity of the curriculum, whereas other skills such as classroom management skills and more general pedagogical skills may be relatively more important at lower grade levels.

As indicators of teacher struggles, we consider information about *teacher health*, namely measures of teacher mental health and total teacher absence (disregarding child-related absence, i.e. absence due to a sick child or parental leave). On average, teachers are absent between 9 and 13 days per year with slight variation across subjects and grade levels. Comparing this number with the average absence in the overall population reveals that teacher absenteeism is much more pronounced than that of the average worker in the population. In 2018, average absence in full-time equivalents for the overall population was about 9 days, where 8.5 of those were due to own sickness and 0.1 were due to work-related accidents

(StatBank Denmark (n.d)). For other municipal employees the corresponding number is just above 13 days (12.9 due to own sickness and 0.2 due to work-related accidents). In terms of mental health, teachers also appear to struggle; 3-5 percent of teachers have in the last 5 years been diagnosed with mental or behavioral disorders or other psychological problems; henceforth mental health diagnoses. In practice, this exercise relies on data from the national patient register that characterizes diagnoses according to the International Statistical Classification of Diseases and Related Health Problems, version 10 (the ICD-10) catalogue. The five most observed diagnoses are: reaction to severe stress and adjustment disorders (DF43, 16%), depressive episode (DF32, 9%), recurrent depressive disorder (DF33, 8%), mental and behavioral disorders due to use of alcohol (DF10, 7%) and other anxiety disorders (e.g., generalized anxiety, panic disorders) (DF41, 7%). Similarly, the share of teachers who in the last 5 years have had a visit to a general practitioner or a specialist related to psychiatric or psychological issues lies between 17 and 28 percent.[7]

Finally, we characterize the teachers in terms of *teaching specific information*, namely their teaching experience, hours taught in the classroom of observation, indicators of challenging classroom compositions, and measures of the size of their peer group. On average, teachers in the sample have 13 years of teaching experience. Danish teachers spend 318 hours with their primary classroom in Danish corresponding to about 1.6 hours per school day.[8] This number decreases substantially by grade level and is also lower for math teachers.

The Danish register data does not inform about whether some students are more challenging than others. Therefore, we rely on previous work using mental health of children and parents

[7] Psychological, psychiatric, and related diagnoses are obtained from hospital registers. The definition used here includes the following ICD-10 codes: F, X60-X84, Z63, Z72-Z73, Z00.4, Z04.6, Z03.2, Z71.3-Z71.6. Visits to a general practitioner or a specialist related to psychiatric or psychological issues are obtained from the health insurance register. The definition used here includes all visits to specialists in psychiatry, children's psychiatry, and psychologic counselling as well as visits to the general practitioner where the service involves treatment or assessment of mental health conditions.
[8] Assuming a school year of 200 days.

and SES status as proxies of disruptive or challenging behavior; see Kristoffersen et al., (2015). Based on this, we define a child as being potentially disruptive if the child or either of the parents have had a mental health diagnosis prior to the year the child turns 7.

The average share of potentially disruptive students in the classroom is about a third in grade 1 and declines over grades. This may partly reflect an outflow of children needing additional support into other more specialized services, but most likely also to some extent reflects that for the older parents, we do not have diagnoses as far back in time. Finally, the share of low-SES students in the classroom is 26 percent regardless of grade. Since the SES measure is defined based on the student's grade 0 cohort, this means that grade repetition and in- and outflow of students after grade 0 is only very weakly related to SES.

Table 1: Descriptive statistics - Danish teachers in grades 1, 4 and 7

Variables	Grade 1		Grade 4		Grade 7	
	Mean	SD	Mean	SD	Mean	SD
Personal Characteristics						
Female (0/1)	0.91		0.86		0.75	
Age	43.48	10.12	43.85	10.14	43.07	10.23
Non-Western descent (0/1)	0.02		0.01		0.01	
Missing basic information (0/1)	0.00		0.00		0.00	
Academic skills						
HS Danish written (std)	-0.06	0.88	-0.02	0.87	0.07	0.89
HS Math written (std)	-0.37	0.94	-0.41	0.94	-0.44	0.96
Missing HS written (0/1)	0.84		0.84		0.84	
HS GPA (std)	-0.17	0.82	-0.16	0.81	-0.09	0.83
Missing HS GPA (0/1)	0.23		0.24		0.22	
Teachers' college (std)	-0.04	0.98	0.04	0.98	0.08	0.97
Missing teachers' college grades (0/1)	0.65		0.65		0.61	
Health						
Teaching absence (days)	12.79	22.94	12.52	23.65	10.65	20.72
Mental health GP or specialist contact (current year) (0/1)	0.10		0.10		0.09	
Mental health GP or specialist contact (last 5 years) (0/1)	0.28		0.27		0.24	
Mental health diagnosis (current year) (0/1)	0.01		0.01		0.01	
Mental health diagnosis (last 5 years) (0/1)	0.05		0.05		0.05	
Teaching specific information						
Teaching experience (years)	13.04	8.91	13.47	9.10	12.92	9.06
Number of teaching hours	317.53	48.21	205.48	34.89	202.08	32.54
Share of potentially disruptive students in classroom	0.32	0.13	0.27	0.12	0.22	0.11
Share of low-SES students in the classroom	0.26	0.17	0.26	0.17	0.26	0.17
Number of primary Danish teachers at school	20.12	8.31	19.78	8.31	21.07	7.24
Number of primary teachers at school	41.79	16.96	41.15	16.96	44.09	14.55
Missing teacher information (0/1)	0.00		0.00		0.00	
Number of observations	14,448		15,292		14,385	

Notes: This table shows means and standard deviations for Danish and math teachers who are primary teachers in a classroom in either Danish or math in one or more school years from 2013/14 to 2019/20. There is one observation per classroom-subject-school year cell. Non-Western descent refers to immigrants or descendants that have a non-Western country of origin. Grades from high school (HS) and teachers' college are standardized within the graduation cohort to have mean zero and standard deviation of one. The course-specific grades are available from 1997 onwards. The high school GPA is available from 1977 onwards. The grade from the teachers' college is the grade from the Bachelor project and are available from 2004 onwards. Teaching absence is the number of days absent in the current school year due to own sickness and work-related accidents. Mental health contact is an indicator for whether such a contact occurred. Psychiatric diagnosis covers both psychiatric, psychological and related diagnoses. Teaching experience is the number of years that the teacher has been working as a teacher. If either the student or the parents of the student have received a mental health diagnosis prior to the year in which the child turned 7, a student is categorized as disruptive. Socioeconomic status (SES) is measured as an index based on parental education and income, cf. Appendix A.1. Students are categorized as low-SES students if they are in the bottom quartile of the SES distribution. The shares of disruptive and low-SES students are based on the classroom, which the observation pertains to. The number of primary teachers at the school is the number of primary teachers in the school year.

Table 2: Descriptive statistics - Math teachers in grades 1, 4 and 7

Variables	Grade 1		Grade 4		Grade 7	
	Mean	SD	Mean	SD	Mean	SD
Personal Characteristics						
Female (0/1)	0.68		0.57		0.43	
Age	42.86	10.29	43.76	10.42	43.07	10.72
Non-Western descent (0/1)	0.03		0.03		0.02	
Missing basic information (0/1)	0.00		0.00		0.00	
Academic skills						
HS Danish written (std)	-0.28	0.90	-0.27	0.90	-0.22	0.89
HS Math written (std)	0.01	0.86	0.01	0.87	0.14	0.87
Missing HS written (0/1)	0.71		0.73		0.68	
HS GPA (std)	-0.19	0.82	-0.18	0.82	-0.09	0.83
Missing HS GPA (0/1)	0.24		0.26		0.24	
Teachers' college (std)	-0.16	0.96	-0.14	0.97	-0.09	1.00
Missing teachers' college grades (0/1)	0.65		0.67		0.62	
Health						
Teaching absence (days)	12.28	22.94	11.42	22.49	9.10	18.80
Mental health GP or specialist contact (current year) (0/1)	0.09		0.08		0.06	
Mental health GP or specialist contact (last 5 years) (0/1)	0.24		0.21		0.17	
Mental health diagnosis (current year) (0/1)	0.01		0.01		0.01	
Mental health diagnosis (last 5 years) (0/1)	0.04		0.04		0.03	
Teaching specific information						
Teaching experience (years)	12.43	8.84	13.64	9.34	13.02	9.33
Number of teaching hours	147.04	22.37	143.47	22.73	142.35	22.55
Share of potentially disruptive students in classroom	0.32	0.13	0.27	0.12	0.22	0.11
Share of low-SES students in the classroom	0.26	0.17	0.26	0.17	0.26	0.17
Number of primary math teachers at school	13.74	5.66	13.53	5.56	14.45	4.97
Number of primary teachers at school	41.84	16.96	41.20	16.95	44.13	14.56
Missing teacher information (0/1)	0.00		0.00		0.00	
Number of observations	14,393		15,252		14,356	

Notes: See Table 1.

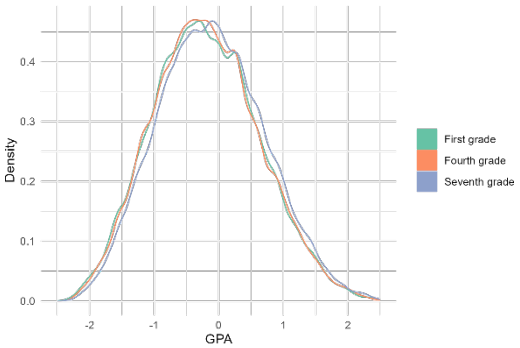
To examine teachers' prerequisite skills in more detail, Figure 1 shows the teachers' high school grade distributions. Figure 1a shows the GPA distribution of teachers at grade levels 1, 4 and 7. We note that these distributions are similar across grades although the distribution for grade 7 teachers is shifted slightly to the right. The grade distributions across Danish and math teachers are also comparable, cf. Figure 1b. When we turn to subject-specific skills in Figures 1c and 1d, we find first that the teacher population is very diverse in terms of the subject-

specific and general academic skills with which they enter the teaching profession. While we see a strong selection by skills into subject specialization (like that reported in Tables 1 and 2), Figures 1c and 1d also reveal that Danish skills are centered around the mean, whereas math skills show a much higher variance for Danish teachers as well as math teachers. For written Danish (math) the average grade for all high school cohorts for all available years is 5.6 (5.2). Furthermore, it is clear that a substantial share of teachers have very low subject-specific prerequisite skills: around 2 percent of Danish teachers in fact failed (i.e., received a grade of -3 or 00) written Danish in high school and as many as 17 percent of math teachers failed written math in high school.[9] Still, more than half of the teachers with either specialization, Danish or math, have prerequisite skills at a level of about average (a grade of 7) and above in the relevant high school course. While about 18 percent of math teachers excelled in written math, only 8 percent of Danish teachers received top grades (i.e. 10 or 12) in written Danish in high school.

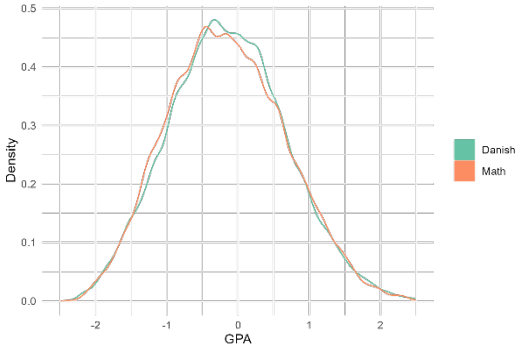
The math teachers who failed the written math exam in high school (N = 1,196) have 8.79 years of teaching experience, 74% of them have a teacher's education, and 33% are teaching grades 1-3. In comparison, the math teachers who did not fail the written math exam (N = 5,359) have 8.11 years of teaching experience, 75% have a teacher's education, and 33% are teaching grades 1-3.

[9] Again, grades are only observed for relatively young teachers. These patterns may diverge from those of older cohorts of teachers.

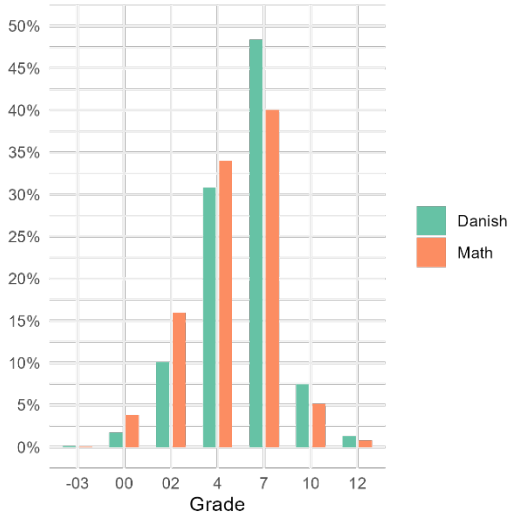
Figure 1: Teachers' prerequisite skills



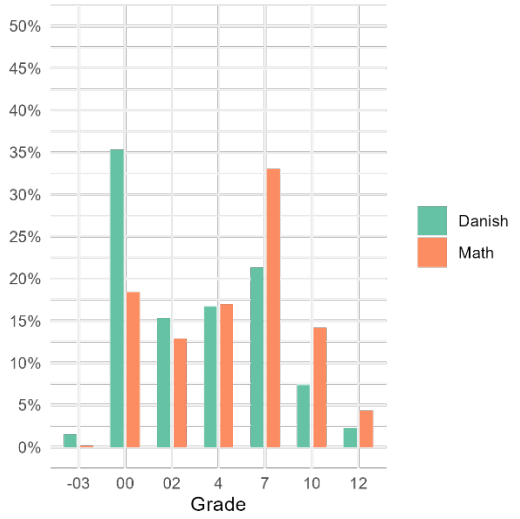
a) High school GPA distributions by grade level



b) High school GPA distributions by subject



c) High school Danish grade distribution



d) High school math grade distribution

Notes: The graphs show Danish and math teachers' prerequisite skills in terms of their high school grades. The GPA from high school (HS) is standardized to have mean zero and standard deviation of one within the graduation cohort. The high school GPA is available from 1977 onwards. The course-specific written exam grades are available from 1997 onwards. Grades on the old grading scale have been converted to the new grading scale. Like Tables 1 and 2, the unit of observation is classroom-subject-year. Thus, a teacher may enter multiple times.

5. Teachers' working conditions

Based on the matched student-teacher data, we characterize teachers' working conditions along the following dimensions: the characteristics of the students that the teachers face, the extent of face-to-face teaching, the versatility of the work, and specialization in subjects and tiers.

Characteristics of the students

Again, for conciseness, we focus on the first grade level in each tier and show descriptive statistics for all students in grades 1, 4 and 7, cf. Table 3. As expected, the gender distribution of students is roughly equal. By Danish law, children should enroll in grade 0 in the year they turn 6 implying that they will be about 7 in grade 1, 10 in grade 4 and 13 in grade 7. However, a non-negligible share of students is below the age-appropriate grade level. Moreover, while this share is 0.09 in grade 1, it does increase to 0.16 in grade 7. This pattern reflects several institutional characteristics. First, most retention happens in relation to school start and before grade 1. Second, some grade retention occurs also later but is limited in scale. Third, there has been a policy shift toward stricter enforcement of the school starting age rules, which means that fewer students in our grade 1 sample could postpone school start as compared to students in our grade 7 sample, cf. Dreyer (2025). In line with Table 1, almost a third of all students are classified as potentially disruptive in grade 1 using our proxy measure based on mental health diagnoses.

Table 3: Descriptive characteristics - all students in grades 1, 4, and 7

Variables	Grade 1		Grade 4		Grade 7	
	Mean	SD	Mean	SD	Mean	SD
Student characteristics						
Female (0/1)	0.49		0.49		0.50	
Age	7.08	0.31	10.11	0.36	13.15	0.40
Non-Western descent (0/1)	0.09		0.09		0.10	
Below age-appropriate grade level (0/1)	0.09		0.12		0.16	
SES (Index 0-100)	50.30	25.59	50.34	25.34	49.58	25.00
Disruptive child (0/1)	0.31		0.26		0.22	
Number of observations	313,909		334,784		323,450	

Notes: This table shows means and standard deviations for students in grades 1, 4, and 7 in one or more school years from 2013/14 to 2019/20 based on the sample including all teachers. There is one observation per student-year cell. Age is the student's age in the school year. Non-Western descent refers to immigrants or descendants that have a non-Western country of origin. Below age-appropriate grade level is an indicator variable equal to one if the student is enrolled at a grade level that is lower than the expected grade level if the student started school on time and has not been retained. Socioeconomic status (SES) is measured as an index based on parental education and income, cf. Appendix A.1. Higher values of the SES index indicate higher SES. If either the student or the parents of the student have received a mental health diagnosis prior to the year in which the child turned 7, a student is categorized as disruptive.

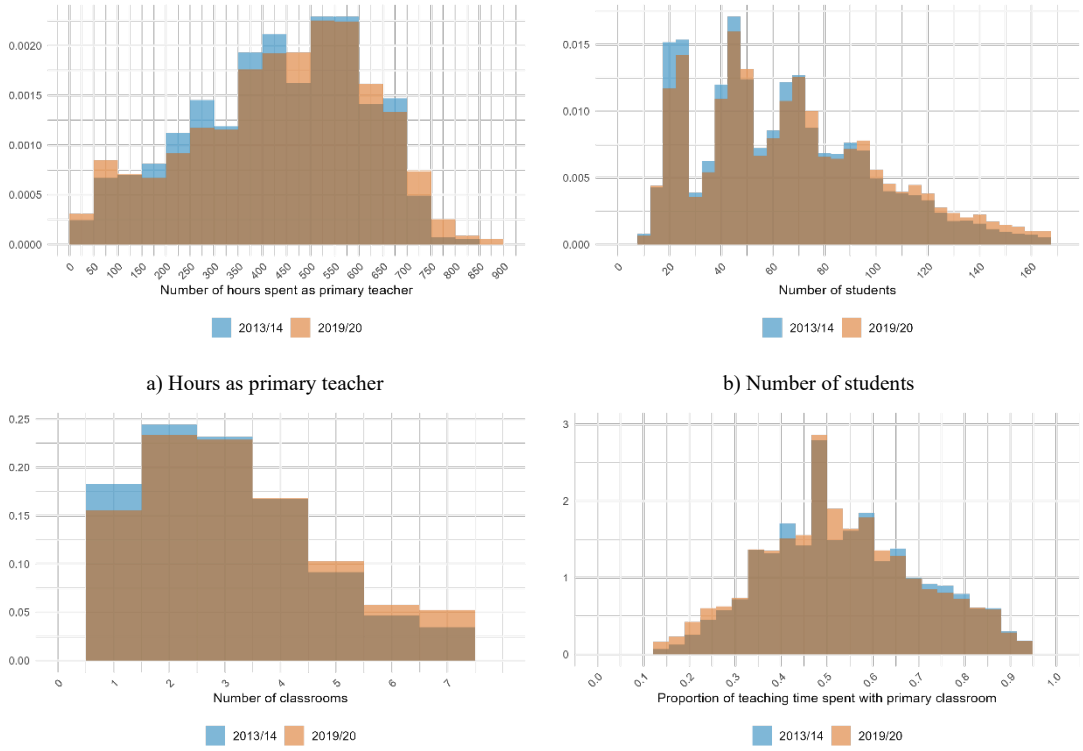
Teaching time and conditions

Teachers spend much of their working time in classrooms, but within a school year there is substantial variation across teachers in the number of hours they spend as a primary teacher in a classroom, the number of students and classrooms they face, and the time they spend with their primary classroom, cf. Figure 2 which shows the relevant distributions. During the school year, the vast majority of teachers spend somewhere between 250 and 700 hours in classrooms as primary teachers, cf. Figure 2a. With 40 weeks of school in a school year, this corresponds to roughly 6-18 hours per week. When interpreting these numbers, as we discussed above, one should keep in mind that data coverage is not perfect in terms of subjects, which will imply that we will tend to underestimate the number of hours spent teaching. While many teachers meet only one to two classrooms during a school year, a large share of teachers meet more than three classrooms, and more than 60 students during a school year, cf. Figures 2b and 2c. Having to relate to many different students and classrooms adds to the complexity of the teacher job. At the same time, teachers do spend more than 50 percent of their time in their primary classroom on average, cf. Figure 2d. Here, the *teacher's* primary classroom is defined as the classroom in which the teacher spends the most time. In addition to the time spent in classrooms, which is what the data informs us about, a substantial amount of teachers' time is spent on administrative work and teaching preparation. Teachers' statutory working time was 1,680 hours in 2017 while teaching hours only constituted 784 of these corresponding to 47 percent (OECD, 2018).[10] In comparison, we find that teachers spend 441 hours as a primary teacher in classrooms on average. In terms of other tasks, teachers list individual planning and preparation as the largest single task and report that they spend 7.2 hours a week on this task in 2018 (corresponding to 288 hours a year), again assuming a school year of 40 weeks (EVA,

[10] Using survey data, EVA (2018) finds that 50 percent of total working hours are spent on actual teaching for grades 7-10 in 2018.

2018). The school reform in 2013/14 that we mentioned above involved major changes to teachers' work agreements and time spent on individual planning and preparation has decreased while actual teaching time has increased (EVA, 2018). Figure 2 displays limited changes from 2013/14 to 2019/20, but there is a tendency for teachers to face a larger number of students and classrooms and to spend a smaller proportion of time with their primary classroom.

Figure 2: Teaching conditions



a) Hours as primary teacher

b) Number of students

c) Number of classrooms

d) Time spent with primary classroom

Notes: The graphs show histograms of different teaching conditions in the school years 2013/14 (N = 33,706) and 2019/20 (N = 34,712). The unit of observation is the teacher. The variables are measured in the relevant school year and all subjects are included (grades 1-9). The primary classroom is defined as the classroom in which the teacher spends the largest share of his/her time in the relevant school year. Some cells have been omitted to ensure compliance with Statistics Denmark's data security policy.

Subject and tier specialization

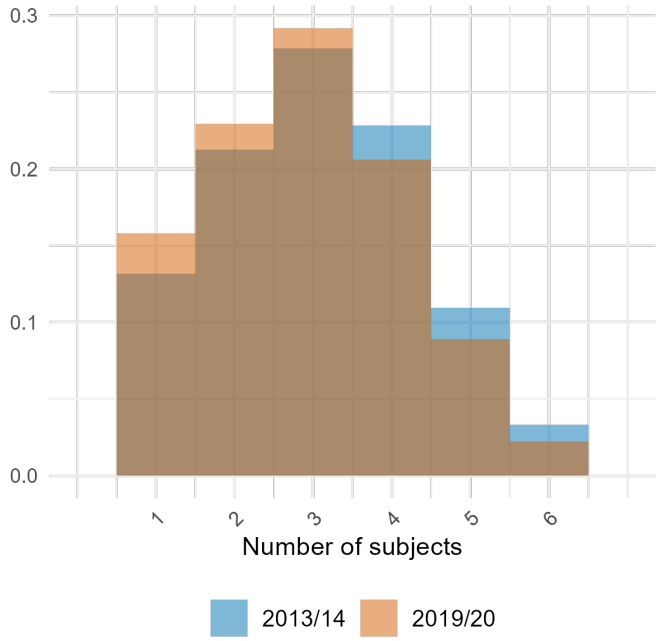
Teachers can specialize in various dimensions, but the three most prevalent are probably 1) subjects, 2) students and 3) grade levels.[11] Teachers in our sample were trained under markedly

[11] Within a given school year 2) and 3) can be overlapping.

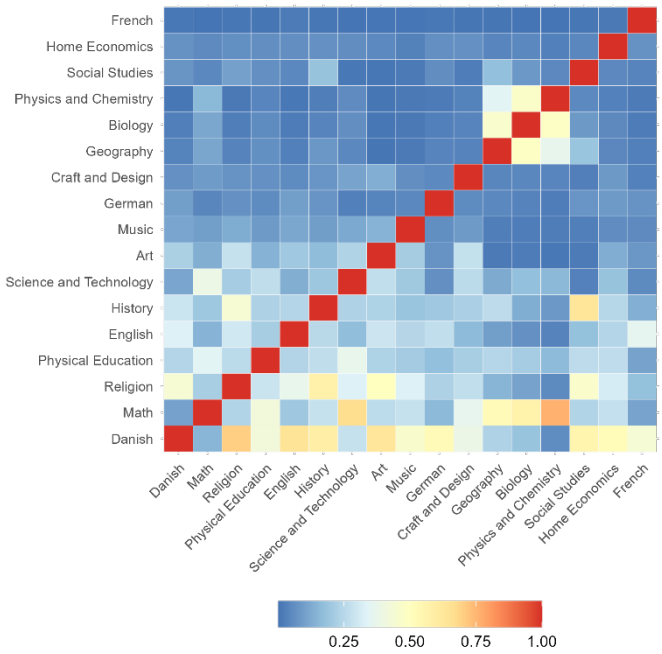
different regulatory regimes, as the teacher education system has undergone numerous reforms. This includes, for example, repeated change of focus between being a generalist who can teach many subjects versus being a specialist with competence in few subjects as well as change of focus between academic versus pedagogical aspects of teaching, cf. Madsen and Jensen (2023).

Figure 3 depicts how teachers specialize in subjects. The typical teacher teaches three different subjects in a school year, and more than 10 percent of teachers teach five or more subjects, cf. Figure 3a. Teachers in Denmark are generally not specialized in one specific subject, and in accordance with this, Figure 3a suggests that teachers – even within a school year – teach several different subjects. The number of subjects taught declined following the school reform; however, it also varies across schools — for instance due to differences in school size or geographical challenges in filling teaching positions — as well as across teacher cohorts, reflecting the different regulatory regimes under which they were trained as mentioned above. In comparison, Figure 3b shows a heat map of observed combinations of teacher subjects. This suggests some degree of teacher specialization within subject areas. For example, Danish is often observed in combination with religion and English, while math is often observed in combination with science and physical education.

Figure 3: Subject specialization



a) Number of subjects taught

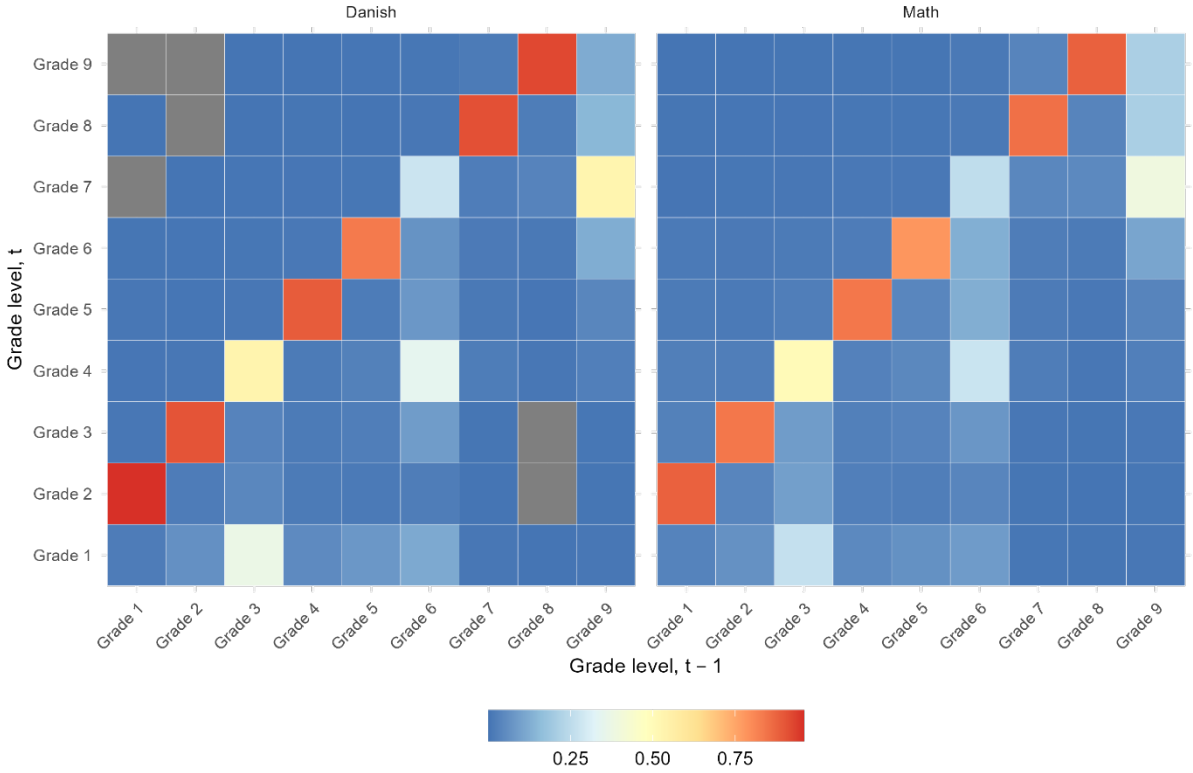


b) Conditional probabilities of teaching subjects

Notes: Panel a) shows a histogram of the number of subjects taught in the school years 2013/14 (N = 33,706) and 2019/20 (N = 34,712). The unit of observation is the teacher. The variables are measured in the relevant school year and all subjects are included (grades 1-9). Some cells have been omitted to ensure compliance with Statistics Denmark's data security policy. Panel b) shows a heat map of the conditional probabilities based on all subject combinations. Each cell represents the probability of teaching a subject (row) conditional on teaching a subject (column) within a given school year.

Figure 2 documented that teachers to some extent specialize in their students in that they spend much of their time with the same classroom within a school year. Teachers can also specialize in a specific pool of students across school years by staying with the same classroom for several years and looping across grade levels. Figure 4 shows a heat map of the movements of Danish (panel A) and math teachers (panel B) across grade levels. This illustrates that teachers tend to specialize in their students. The probability of a teacher teaching a grade 2 classroom in year t given that he or she taught a grade 1 classroom in year t-1 is above 75 percent. The grade level transitions generally follow this pattern with the exception that at the last grade level of each tier, it becomes much more likely for the teacher to pick up a classroom at a lower grade level in the following school year. After grade 3, teachers are almost equally likely to teach a grade 4 and a grade 1 classroom. After grade 6, teachers are almost equally likely to teach a grade 7 and a grade 4 classroom. After grade 9 when students continue to upper secondary education, teachers are most likely to teach grade 7. Overall, teachers are highly specialized in their students and follow them for several years with separations being more pronounced after grades 3 and 6. Thus, specialization in a specific grade level is uncommon. On the other hand, specialization in specific tiers (groups of grade levels) is widespread. Although, the most common tier organization is grades 1-3, grades 4-6, and grades 7-9, the tiers are by no means set in stone cf. Figure 4.

Figure 4: Grade level specialization and looping



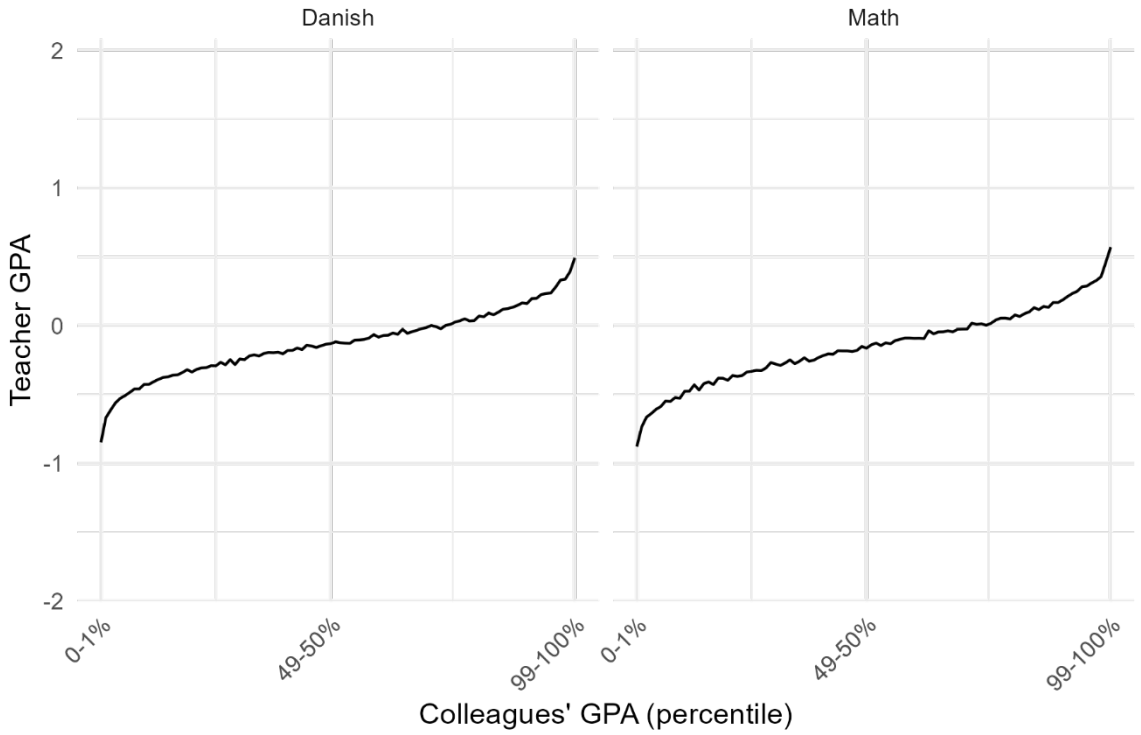
Notes: The figure shows a heatmap of the probability of teaching grade a grade level in year t (rows) conditional on teaching a grade level in year t-1 (columns). Probabilities are based on all same-subject transitions of Danish (left panel) and math (right panel) teachers. The number of transitions is 85,797 and 85,895 for Danish and math teachers, respectively. Some cells (marked in grey) have been omitted to ensure compliance with Statistics Denmark's data security policy.

Colleagues

Teachers' colleagues potentially play a large role in terms of the work environment and the quality of the peer interactions and feedback obtained. Teacher skills are likely multi-faceted but one possible characterization of colleagues is in terms of their academic skills as measured by their high school GPA. To the extent that teachers sort by such skills, however, some schools will experience lower quality of the collegial network. To get an idea about such behaviors, Figure 5 illustrates sorting of teachers across schools based on teachers' high school GPA. In a world with no sorting of teachers to schools, we would expect the pattern to be horizontal, but we see a positive slope indicating that low-ability (high-ability) teachers tend to be teaching in schools with other low-ability (high-ability) teachers. The figure illustrates a marked difference in skills between the poorest and best collegiate networks. At the bottom of the distribution,

the average GPA is almost 1 SD below the population mean indicating that the average teacher at the school had a GPA at the 15th-16th percentile of his high school cohort's distribution, while at the top schools, the average teacher had a GPA 0.5 SD above his high school cohort's population mean indicating an average rank at the 70th percentile. In other words, the average teacher at the best schools would also be qualified for competitive university programs.

Figure 5: Sorting of teachers across schools



Notes: These graphs show the teacher GPA from high school by the percentile of colleagues' average GPA for Danish teachers (left) and math teachers (right). The GPA from high school (HS) is standardized to have mean zero and standard deviation of one within the graduation cohort. The high school GPA is available from 1978 onwards. Observations are binned according to their percentiles of colleagues' average GPA, 0-1% etc. The unit of observation is teacher-school-subject-school year in which the colleagues are defined as other teachers teaching the same subject at the same school in the same school year.

6. Teacher struggles

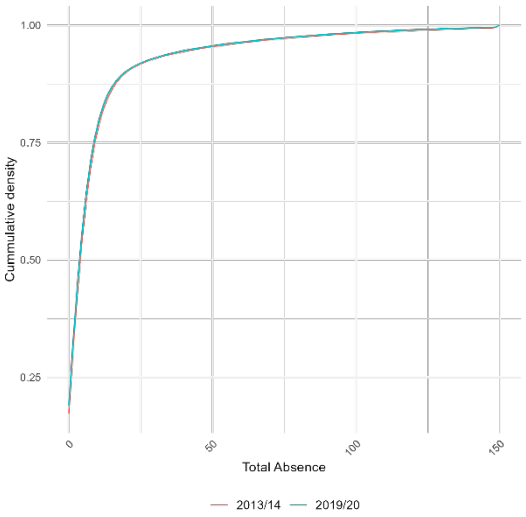
This section finally focuses on a variety of indicators of teacher struggles. To get a sense of the extent and variety of teacher struggles and work-life balance, we examine teachers' absence from work, mental health diagnoses and contacts, and turnover patterns. We focus on variation

by school year (2013/14 versus 2019/20), by gender and by the number of disruptive students (above/below the median of 24%)

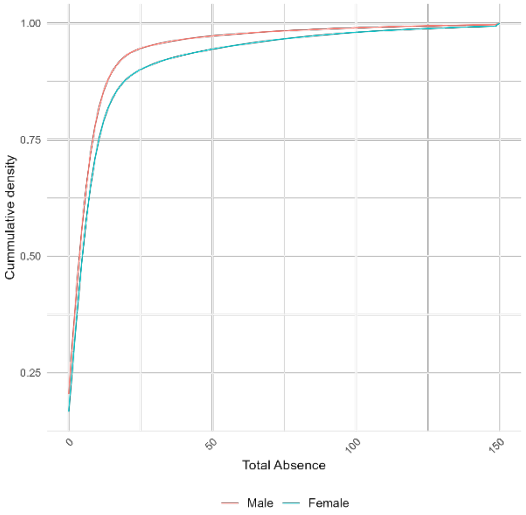
Absence from work

Figure 6 illustrates the cumulative distribution of total absence by school year, by sex and by the number of disruptive students (above/below median, 24%) for Danish and math teachers. The median is almost equal across all subgroups at 6 days. The median is far below the means of 9-13 days reported in Tables 1 and 2, which reflects that absence is unevenly spread across teachers. There is a clear gender pattern; at the right tail of the distribution, females have much more absence than males; the top decile for females is almost twice as large as for males (cf. Figure 6b). There are only minor differences at the right tail of the distribution by school year and by the number of disruptive students (cf. Figures 6a and 6c). This is consistent with Bennedsen & Schlier (2025), who argue that incentives and organizational culture (as opposed to individual differences) explain much more than half of teacher absenteeism.

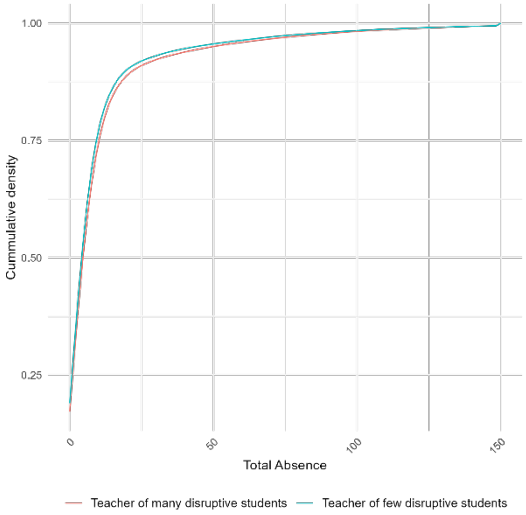
Figure 6: Teacher absence



a) By school year



b) By sex



c) By number of disruptive students

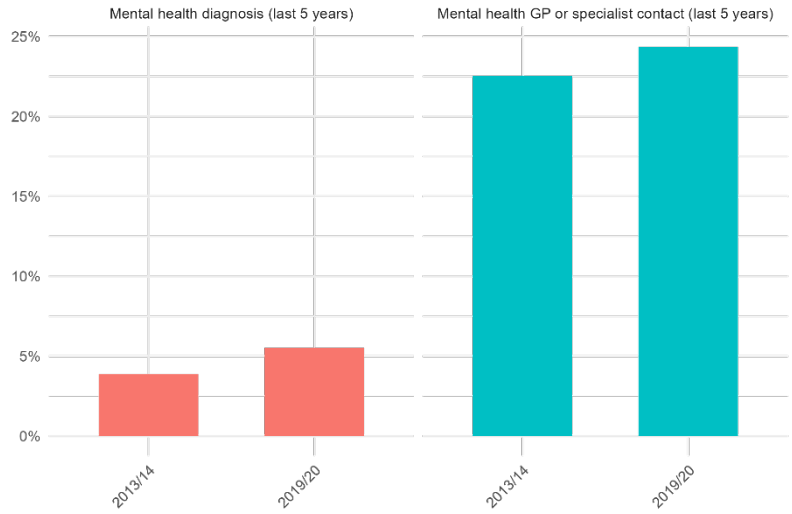
Notes: The graphs show the cumulative distribution of the number of days the teacher has been absent due to own sickness and work-related accidents in the school year for Danish and math teachers. There is one observation per teacher-school year cell. In panel c), we define the teacher's primary classroom as the classroom in which the teacher spends the most time. Based on the primary classroom, we categorize the teacher as having many (few) disruptive students if the share is above (below) the median of 24%. In case of ties, the share of distruptive students are calculated as the mean across both classrooms. Due to limited observations in the right tail of the absence distribution, the number of days absent is censored at 150 days.

Mental health

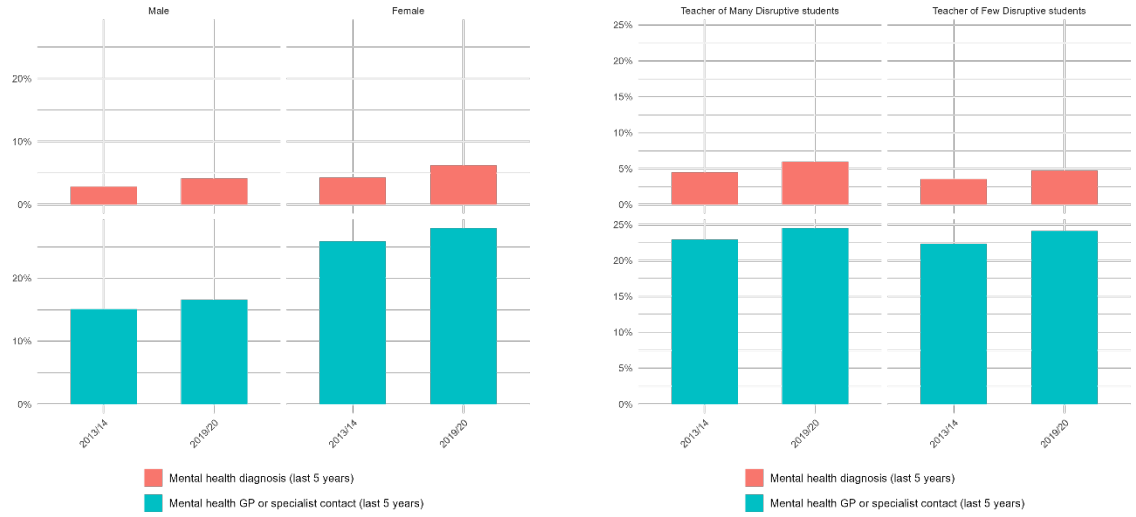
Figure 7 describes mental health of Danish and math teachers along two dimensions: the fraction of teachers who have received a mental health diagnosis within the last five years and the fraction who have had a mental-health related contact with a GP or a specialist within the

last five years. The percentage of teachers who have had mental health issues has increased for both measures (cf. Figure 7a). While the level is somewhat higher for females than males, the relative increase over time is similar across sex (cf. Figure 7b). Teachers who are exposed to many disruptive students (as opposed to few) have about one percentage point higher incidence of mental health diagnoses and contacts. In comparison, a study from Sweden finds that a one standard deviation increase in an index of student disadvantage leads to an increase in stress-related sick leave of 8.7 percent (Karbownik et al., 2026) suggesting that these differences may reflect an underlying causal relationship between student composition and teacher mental health.

Figure 7: Teachers' mental health



a) By school year



b) By sex

c) Number of disruptive students

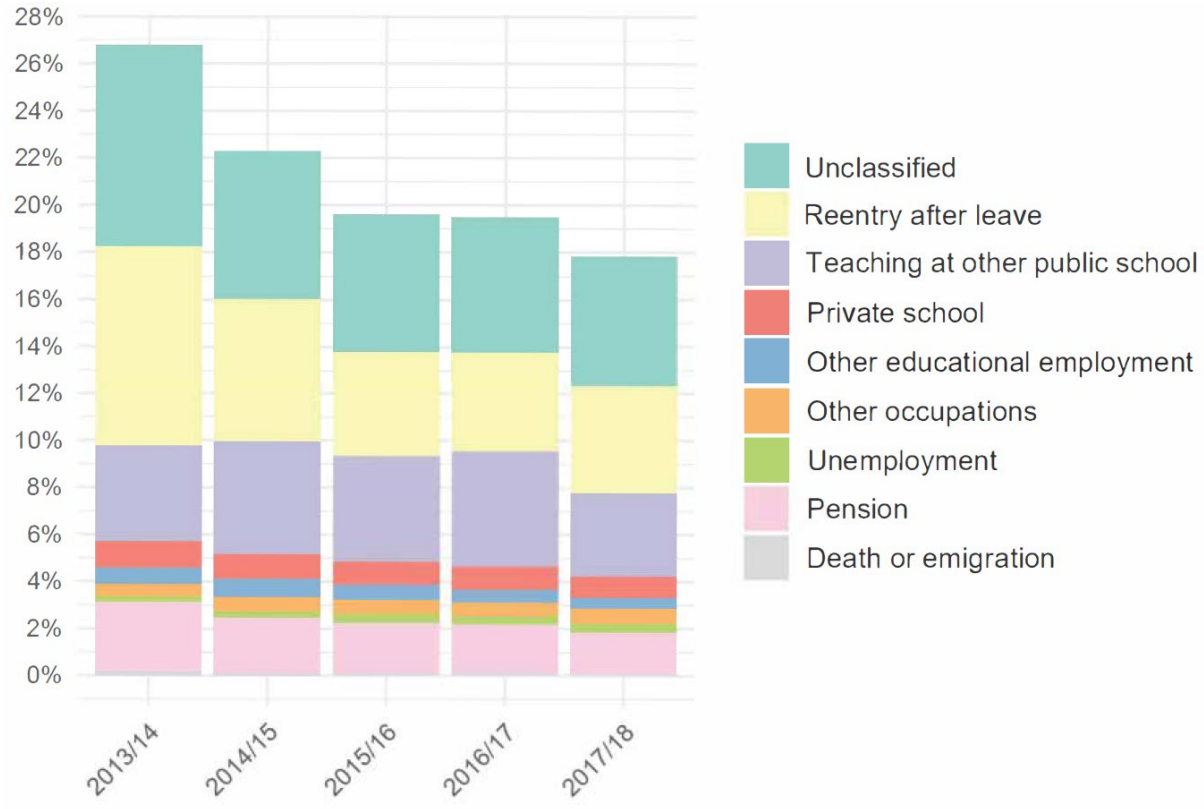
Notes: The graphs show two indicators of mental health for teachers. There is one observation per teacher-school year cell. In panel c) many (few) disruptive students is defined as above (below) the median of 24%. In panel c), we define the teacher's primary classroom as the classroom in which the teacher spends the most time. Based on the primary classroom, we categorize the teacher as having many (few) disruptive students if the share is above (below) the median of 24%. In case of ties, the share of distruptive students are calculated as the mean across both classrooms.

Turnover

Figure 8 shows the rate of teachers who are observed teaching at a given public school (s) in year t (say 2013/14) but not in year t+1 (say 2014/15). The turnover rate declined from 27 percent in 2013/14, which was the year of the school reform, to 18 percent in 2017/18. While some of the turnover is unclassified as we cannot detect in the available registers where the

teachers go, the dominant categories are transition to/from a period of leave (5-8 percent), transition to another public (4-5 percent) or private school (around 1 percent) or retirement (2-3 percent). The main explanation for the decline during the period is reduced leave-taking and retirement. Given the definition of turnover used here, turnover may also be higher in 2013/14 due to slightly lower coverage of the matched student-teacher register in the first years.

Figure 8: Teacher turnover



Notes: This table shows the percentage of teachers who are primary teachers in normal classrooms in any subject in school s in year t, but who are not teaching at school s in year t+1 based on the register UDDLAERER. Each bar is decomposed into common exit states. The state "other" public school covers teachers who no longer teach at school s, but are observed teaching at a different public school. The "reentry after leave" state covers teachers who are not teaching at school s in year t+1, but is observed teaching at school s in year t+2. The remaining exits are classified based on other registers. Individuals who stay employed at the same school, but experience a shift from teaching tasks to non-teaching tasks will be included in the unclassified category. The "private school" state includes teachers who leave to teach at schools not in UDDLAERER or perform non-teaching tasks at other schools than school s.

7. Conclusion

We use register-based matched student-teacher data to characterize the working lives of teachers. Our findings inform both the interpretation of education research and the design of policies aimed at improving teacher retention and wellbeing.

We document substantial gender segregation across subjects and grades, with female teachers dominating Danish instruction, especially in lower grades, and male teachers being more prevalent in upper-grade math teaching. From an education policy perspective, this type of specialization is not a problem *per se*, although diversity along various dimensions tends to be beneficial. First, Finnish research has shown positive effects of a male quota at teacher's college suggesting that skills other than academic grades are important (Schaede and Mankki, 2025). Second, a multi-country study suggests that students tend to benefit from same-sex teachers, although effect sizes are moderate in magnitude and only universally positive for secondary school students (de Gendre et al. 2024).

We find strong selection into subjects based on subject-specific academic skills, which is reassuring since teachers seem to be allocated based on comparative advantages. While Danish grades are centered around the mean, we see considerable skill dispersion in math grades. Among math teachers, in fact, we find that as many as 17 percent have failed written math in high school, which suggests poor pre-requisite skills in the subject of specialization. Although education research suggests that teachers' own educational background is not necessarily tied to the value added of their students (e.g. Hanushek and Rivkin 2006, Thijssen et al. 2022), the thickness of the lower tail suggests additional focus on teachers' prerequisite skills may be warranted. This pattern emphasizes that attention of education policy should be on recruiting more highly qualified math teachers, perhaps through alternative routes than teachers' colleges and perhaps using untraditional incentive schemes.

For one or two decades, a key question in education policy and research has been how to attract and retain good teachers. The core theme here is the link between working conditions and job satisfaction, which involves a more comprehensive understanding of teachers' struggles. Our paper shows that the average amount of absenteeism is about 33% higher than that of the overall labor market with a thick right tail. Furthermore, mental health struggles are common and increasing (like the rest of the labor market). Finally, exit out of the teaching profession is high year after year. While these statistics suggest that the struggles are prevalent, it is not straightforward to fix these issues. Policy makers could perhaps make reentry to the profession easier, or they could facilitate access to treatment for work-related mental health struggles.

The school reform in 2014 was a milestone in Danish education policy. Our study partly reveals how the working lives of teachers changed after the reform. Teachers teach fewer subjects and meet more students and more classrooms during a school year at the end of our observation period compared to the year before the reform. This suggests that they largely teach subjects aligned with their competences from teachers' college or acquired later as was a stated goal of the school reform. Turnover did peak at 27 percent between 2013/14 and the reform year 2014/15, which may reflect lower coverage of the matched teacher-student data in the early years, but may also reflect teachers' dissatisfaction with the school reform, but it gradually fell and was down to 18 percent in 2017/18.

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Appendix A

A.1 Construction of SES index

The index of socioeconomic status (SES) ranges from 0 to 100. The index is calculated in the following steps:

1) Calculate the percentile rank for education (11 categories corresponding to increasing level of education) and income separately for mothers and fathers.
2) Calculate the average parental rank for education and income separately.
3) Calculate the percentile rank for the average parental rank for education and income separately
4) Calculate the average of the parental percentile rank for education and the parental percentile rank for income.

The result of step 4) is the SES index used in the analyses. All rankings are done within the student's school cohort. The school cohort is defined as the year they enter grade 0. In cases where both income and education are missing, but the parent is observed in the population register in the year the child turns 5, parental income is set to zero and parental education to the lowest education level. Otherwise, the percentile rank of the missing parent is set equal to the percentile rank of the other parent. If both parents have no information about income and education and are not observed in the population, the SES index will be missing.

A.2 Appendix Tables

Table A1: Sample selection

Description	Number of students	Number of classrooms	Number of teachers
All observations in UDDLAERER in school years 2013/14 - 2019/20	862,118	159,535	73,911
Regular classrooms in grades 0-9	845,901	147,237	70,334
Primary teachers and classroom size >5 students	843,765	146,337	63,351
Excluding grade 0	795,932	133,199	60,857

Notes: This table shows the sample selection including the number of students, classrooms, and teachers in each step.

Appendix Table A2: Descriptive statistics - all teachers in grades 0, 1, 4, and 7

Variables	Grade 0		Grade 1		Grade 4		Grade 7	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Personal Characteristics								
Female (0/1)	0.95		0.77		0.68		0.59	
Age	48.94	8.68	43.01	10.44	43.60	10.58	43.14	10.75
Non-Western descent (0/1)	0.02		0.02		0.02		0.02	
Missing basic information (0/1)	0.00		0.00		0.00		0.00	
Academic skills								
HS Danish written (std)	-0.32	0.89	-0.17	0.91	-0.16	0.90	-0.11	0.90
HS Math written (std)	-0.47	0.96	-0.21	0.94	-0.22	0.94	-0.14	0.95
Missing HS written (0/1)	0.93		0.79		0.80		0.77	
HS GPA (std)	-0.63	0.80	-0.20	0.84	-0.19	0.83	-0.11	0.83
Missing HS GPA (0/1)	0.53		0.25		0.26		0.25	
Teachers' college (std)	— — —		-0.11	0.99	-0.09	0.99	-0.04	0.99
Missing teachers' college grades (0/1)	— — —		0.67		0.66		0.63	
Health								
Teaching absence (days)	11.91	23.97	12.80	23.58	12.47	23.69	10.48	20.67
Mental health GP or specialist contact (current year) (0/1)	0.08		0.10		0.10		0.08	
Mental health GP or specialist contact (last 5 years) (0/1)	0.24		0.27		0.26		0.22	
Mental health diagnosis (current year) (0/1)	0.01		0.01		0.01		0.01	
Mental health diagnosis (last 5 years) (0/1)	0.04		0.05		0.05		0.04	
Teaching specific information								
Teaching experience (years)	12.46	7.44	11.82	8.95	12.63	9.26	12.46	9.30
Number of teaching hours	598.53	184.19	171.55	144.67	142.47	105.38	131.08	89.61
Share of disruptive students in classroom	0.34	0.13	0.32	0.13	0.27	0.12	0.22	0.11
Share of low-SES students in the classroom	0.27	0.18	0.26	0.17	0.25	0.17	0.26	0.17
Number of primary teachers at school-grade level	2.53	1.14	7.54	3.11	10.23	3.79	13.02	4.60
Number of primary teachers at school	41.61	17.44	41.97	16.92	41.54	16.86	44.36	14.51
Missing teacher information (0/1)	0.00		0.00		0.00		0.00	
Number of observations	13,135		59,996		88,841		95,026	

Notes: This table shows means and standard deviations for all teachers who are primary teachers in a classroom in any subject in one or more school years from 2013/14 to 2019/20. There is one observation per teacher-classroom-school year cell. In other words, for each classroom there is one observation per unique teacher assigned as primary teacher in any subject. If a teacher teaches several classrooms at one grade level, the classroom variables are for the classroom where the teacher spends the most hours. Non-Western descent refers to immigrants or descendants that have a non-Western country of origin. Grades from high school (HS) are standardized to have mean zero and standard deviation of one. The course-specific grades are available from 2001 onwards. The high school GPA is available from 1978 onwards. The grade from the teachers' college is the grade from the Bachelor project and are available from 2003/2004 onwards. Teaching absence is the number of days absent in the current school year. Mental health contact is an indicator for whether such a contact occurred. Psychiatric diagnosis covers both psychiatric, psychological and related diagnoses. Teaching experience is the number of years that the teacher has been working as a teacher. If either the student or the parents of the student received an F diagnosis prior to the year in which the child turned 7, a student is categorized as disruptive. Socioeconomic status (SES) is measured as an index based on parental education and income. Students are categorized as low-SES students if they are in the bottom quartile of the SES distribution. The shares of disruptive and low-SES students are based on the classroom, which the observation pertains to. The number of primary teachers at the school is the number of primary teachers in the school year.