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Working Paper

Leaving Their Mark: Using Danish Student Grade Lists to Construct a More Detailed Measure of Historical Human Capital

EHES Working Paper, No. 207

Provided in Cooperation with:

European Historical Economics Society (EHES)

Suggested Citation: Ford, Nicholas; Ranestad, Kristin; Sharp, Paul (2021) : Leaving Their Mark: Using Danish Student Grade Lists to Construct a More Detailed Measure of Historical Human Capital, EHES Working Paper, No. 207, European Historical Economics Society (EHES), s.l.

This Version is available at:

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EHES Working Paper | No. 207 | February 2021

Leaving Their Mark: Using Danish Student Grade
Lists to Construct a More Detailed Measure of
Historical Human Capital

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Abstract

We provide a brief overview of the educational history of Denmark and document archival and printed sources covering the development of primary, secondary, and tertiary education. In particular, we focus on student grade lists, which are available for individuals at all levels of education from the early nineteenth century until well into the twentieth century. We suggest that these can be used to construct more detailed measures of human capital than those usually employed, making it possible to deconstruct aggregate education into e.g. knowledge of science or humanities, as well as to measure the extent to which this was actually learned, as captured by the grades achieved. Given the role usually attributed to human capital for development, and perhaps particularly with regards the Nordic countries, such data has the potential to greatly increase our understanding of how Denmark became the rich and successful country it is today.

JEL Codes: I21, N33, N34

Keywords: Denmark, grade lists, human capital

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* We would like to thank Christian Larsen for helpful advice on archival material and acknowledge generous funding from the Carlsberg Foundation and *Jan Wallanders och Tom Hedelius stiftelse*.

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1. Introduction

Why is the Nordic region so successful, and what is the role of human capital for this? Human capital has been defined as “the knowledge, skills, competencies and attributes embodied in individuals that facilitate the creation of personal, social and economic well-being” (*OECD Insights: Human Capital*), but scholars have so far been limited to simple statistics such as literacy rates, years of schooling, and the like – all of which clearly fail to capture the breadth and nuances of a true measure. This has meant that it has not been possible to answer satisfactorily some of the biggest questions in the fields of economics and other social sciences, history, and demography. In the present work, we document archival and published sources for Denmark, principally grade lists for individual students in primary, secondary, and tertiary education, which we suggest can be used to construct much more detailed measures.

A systematic historical analysis of the role of human capital for Danish development is timely for several reasons. Together with its Nordic neighbors, it is one of the countries with the lowest economic inequality and highest social mobility, and has a generous welfare state, covering health, education and social security for all. As well as being one of the richest countries in the world, Denmark is also ranked highly on the Human Development Index, and in terms of women’s rights, education and work opportunities, as well as more abstract concepts such as freedom, safety, and, famously, happiness. This was not always the case, however. The Denmark of the eighteenth century was in a miserable state, characterized by frequent losses in war to Sweden and an associated shortfall of public revenue, environmental collapse (Kjærgaard 1994, Khaustova and Sharp 2015, Jensen et al 2020a, Jensen et al 2020b) and serfdom-like institutions under an absolute monarch (Jensen et al 2018). Serfdom was abolished in 1800 and this, together with an extensive program of agrarian reform (Boberg-Fazlic et al 2020b) and a process of enlightenment led by landed elites (Boberg-Fazlic et al 2020a, Lampe and Sharp 2018) eventually culminated with rapid development in the final decades of the nineteenth century. For this, education is considered to have played a key role, with a plentiful provision of agricultural extension services and schooling and human capital-intensive improvements in e.g. accounting (Lampe and Sharp 2017, 2019).

Outside of agriculture it has been noted that the Danish population became literate early, and indeed the high literacy in Scandinavia is often used as an explanation for those countries’ high economic growth during the last two centuries. Lars Sandberg demonstrated that there is a correlation between countries with high literacy in 1850 and those with high income per capita in 1970, even if they were poor in 1850. His argument is that a literate Scandinavian population did not necessarily lead to immediate economic growth, but gradually changed and prepared people for a capitalist way of

thinking (Sandberg, 1982). Although this study has been criticized (O'Rourke and Williamson, 1995, p. 309)¹, his studies have set a standard for the argument that high literacy and early schooling facilitated Scandinavia's strong long-term economic development. According to Carlo Cipolla, more than 70 percent of the adult population in Denmark was literate by 1850, and the Scandinavian countries were some of those with the highest literacy rates in Europe by that time (Cipolla, 1969, p. 113).² Fritz Hodne indicates that in 1873, around 87 percent were able to write and read and 99 percent were able to read in Denmark (Hodne, 1981, p. 250). Other sources show that by the 1890s the estimated literacy rate was close to 100 percent (O'Rourke and Williamson, 1995, p. 299).

As we will discuss below, much of this has to do with an early introduction of compulsory primary schooling in 1739. This has the implication that we need to look beyond typical measures such as literacy when considering the role of human capital for Danish development. Intermediate and higher-level education was not mandatory, and yet certainly provided certain advantages, i.e. increased social status or better paid jobs, and might also have had a significant effect on industrial development and innovation. In the light of this, it turns out to be fortunate that schooling in Denmark is particularly well-documented, with annual lists of grades for individuals in all subjects published from the beginning of the nineteenth century for secondary and tertiary education. We do however also discuss primary schooling, where surveys of schools are available from the early eighteenth century (considering the quality of teaching, facilities, etc.) and we also have access to grade lists from the early nineteenth century.

The remainder of this paper proceeds as follows. In the following section, we present a historical overview of the educational system in Denmark from the eighteenth century, and in Section 3 we document the sources available, primarily grade lists. Section 4 concludes with some suggestions about what these could be used for in terms of constructing more detailed measures of human capital on the individual level, as well as potential applications of the data.

¹ Kevin O'Rourke and Jeffrey Williamson downgrade schooling in their analysis of Sweden, and Scandinavia. Focusing on the period between 1870 and WWI, according to them it was only "modestly important" to the catching-up of these countries. They conclude that: "...while schooling certainly helped make the late nineteenth century Scandinavian catch up possible, it was not the central carrier implied by so much of the literature."

² Denmark, Faroe Islands, Finland, Germany, Holland, Iceland, Scotland, Sweden and Switzerland.

2. Historical Background

Literacy and primary schooling

The early high literacy rates in Denmark, and Scandinavia in general were related to widespread and accessible education systems and early campaigns to improve reading and writing skills. Religious movements and the church played an important role for this (Bruland, 2006, p. 271). The first real education law in Denmark was from 1708. School districts were established in 1720 and in 1721 there were 240 *rytterskoler* ("cavalry schools") in the monarchy.³ Although the state gradually took over the responsibility for these, the church continued to play a key role. An Ordinance on the Confirmation of Youths came in 1736, which determined that being able to read the Bible would be required before they could be confirmed by priests. People who were not confirmed could not take an oath, and without being able to take an oath, they were excluded from a wide range of private and public functions in life. To ensure that youngsters could read the Bible, the school system had to be intensified and improved. The new school laws were drafted by the Danish Chancellery, but administered locally by the bishop and prefect (*stiftsamtmand*), by the provost (*prost*) and the church patron (i.e., landowner or the county governor) at provost level, while the daily supervision of schools and instruction lay with the parish priest. Compulsory primary education was established in 1739 (Feldbæk, 1990, pp. 184-185) and new school laws were introduced in 1806 and 1814, which established improved municipal primary schools and independent schools in the countryside, and introduced the *folkeskole* (known as *almueskole* until 1894) (Feldbæk, 1990, p. 187). From 1814, every child (boys and girls) was supposed to receive seven years (from 7 years old to 14 years old, until they were confirmed) of free schooling (Nellemann, 1966). The number of years children went to school might vary, but keeping children out of school could result in fines for the parents, or the farm owner where servants worked. In 1855, this obligation changed from compulsory schooling to compulsory education, such that parents and guardians of children could (under the supervision of authorities) assume responsibility for teaching their own children.

In the latter third of the nineteenth century, there was still a difference between the schools in the countryside and those in the cities. The schools and the teachers' qualifications improved both in the cities and in the countryside, but in the countryside the number of children in each class was higher

³ The schools were set up according to the division of the country into military districts. The schools functioned as "almueskoler" and were mostly built in the immediate vicinity of the church, as it was usually the pastor who was responsible for the teaching.

than in the cities; the children had fewer subjects and poorer teaching materials, and they went to school for a shorter time (Gjerløff and Faye Jacobsen, 2014).

From the nineteenth century, the Danish educational system was strongly influenced and shaped by the ideas of the pastor, teacher and politician N. F. S. Grundtvig, who advocated new teaching and pedagogical methods involving creativity, poetry and active participation in society and popular life. He stood for the foundation of “folk high schools”, which were schools for adult education that did not necessarily grant academic degrees. The Education Act of 1894 formalized the *folkeskole* (“public school”; government-funded primary education system). The very concept of *folkeskolen* was first used in the laws of 1894 and 1899 and reflected a new view of the general population aimed for its inclusion at all levels of society (Gjerløff and Faye Jacobsen, 2014). In 1903, a four-year middle school for children from 11 years of age was introduced, which then became a requirement to be enrolled in high school (*gymnasium*). Since 1953, the Constitution has stipulated that instruction (teaching) in the *folkeskole* is free of charge.

Secondary education

The secondary education system (high school) in Denmark has its origin in the cathedral and monastical schools established by the Roman Catholic Church in the early Middle Ages. The first high school (*gymnas*) in Denmark was established in Odense in 1621. In Denmark, and also Norway, *gymnas* prepared students for “*examen artium*”, a system that was introduced in 1630, and which was a requirement to enter university (Gjerløff and Faye Jacobsen, 2014). High schools (including “Latin schools”⁴) expanded over the nineteenth century in terms of more schools and students, but high school attendance was not mandatory, unlike primary education. High school attendance might then be viewed as an opportunity for young people to enroll in university-level programs, to gain higher social status, or to get more interesting, or better-paid, jobs. In 1850, the *examen artium* was transferred from the university to the high schools (including the Latin schools). In 1871, the high school education was divided into two lines of study; the “mathematical-scientific” and the “linguistic-historical” programs.⁵

⁴ From the sixteenth century, there were Latin schools in virtually all market towns, set up by the church, where teaching for the youngest students were given in Danish, while Latin was the general language of instruction. The Latin school became *den lærde skole* with the reforms of 1805 and 1809.

⁵ “*Studentereksamen*”. *Den Store Danske* (in Danish). Gyldendal. 4 March 2013. Retrieved 13 January 2016.

Until 1903, *lærde skoler* (the old Latin schools) constituted a separate school system that lasted six years (from 1871, seven years), where the children went through the entire parallel school course. These schools were independent from *almueskolen* (and *folkeskolen*). With the legislation of 1903, *lærde skoler* and *almueskolen* became connected by means of the “middle school”, which allowed for talented pupils from the primary school to be subsequently enrolled in the three-year high school.

High school was thereafter based on a four-year middle school degree. This law also gave girls access to the public high schools (previously they had only had access to private education). The three school levels were brought under one system which connected primary school, middle school, and high school (*enhedsskole*). It should be noted, however, that to ensure that only the best pupils continued to middle and high school, a number of entrance and graduation exams were adopted to act as a sorting mechanism (Gjerløff and Faye Jacobsen, 2014). Also in 1903, the lines of study were changed to “mathematical-scientific”, “modern-lingual”, and “classical-lingual”, and the name of the schools was officially changed to *gymnasium* (Haue, 2006).⁶ Changes were made in the high school study programs in 1958 and a new and more flexible system where the students could choose more freely between subjects was introduced in 1988, and again reformed in 2005 (Haue, 2006).

Finally, it might be noted that the middle school from 1903 was in 1937 supplemented with a middle school which did not require an exam, called “the practical middle school”, which was offered to youngsters who did not aim to continue with high school.

Technical and higher (tertiary) education

The University of Copenhagen was established in 1479.⁷ The University of Kiel, located in Schleswig-Holstein (then under the Danish monarchy), was established in 1665. The University of Aarhus was founded in 1928, and later other universities in Odense, Aalborg and Roskilde opened. Technical education also started quite early in Denmark. The Polytechnic University of Denmark (today the Technical University of Denmark) was established in 1829 and offered courses in natural sciences and mechanics. The Royal Veterinary and Agricultural University opened in 1856 and provided study

⁶ "Gymnasieskolen: Loven om højere Almenskoler 1903". Undervisningsministeriets historie 1848-2004. Undervisningsministeriet. Archived from the original on 16 December 2008. Retrieved 13 January 2016.

⁷ Scania, in the Southern part of Sweden, was part of Denmark until 1658, and it should be noted that *Akademiet* (often seen as a forerunner to Lund University) was founded in Lund in 1438, which makes this the first university in Denmark, and in the Nordic countries.

programs in agriculture, agricultural economy and natural resource management. Finally, the military school opened in 1868.

Although the Scandinavian countries are today far ahead when it comes to women's rights, they were not historically in the forefront in terms of women's access to higher education. Until 1875, women were excluded from the higher education system in Denmark. From that year, women were allowed to take the final high school exam, and thus enter university. By this time, high schools for women had already been introduced elsewhere in the world. For example, high schools for women were introduced in Russia already in 1786 and in 1826 in New York and Boston (Engel, 2004, p. 65; Olsen, K., 1994, p. 113).

Technical education was also provided at an intermediate level. Copenhagen Technical School (*Det tekniske Institut*) was founded in 1843 and offered study programs in all crafts for confirmed children. It was organized by the Technical Society (*Det tekniske Selskab*) and was financed by state funds, The Craftsmen's Association (*Haandværkerforeningen*) in Copenhagen and several guilds. In 1868, a New Craftsmen's School opened (*Ny Haandværkerskole*), which merged with Copenhagen Technical School in 1876. Moreover, a number of technical schools, mostly Sunday schools, were established all over the country in towns and in the countryside, and aimed to provide different types of technical and professional training related to craftsmanship for youngsters. Finally, agricultural schools were established from the first half of the nineteenth century and were found to be vital in the training of farmers and dairymen for the important dairy industry in the country that developed rapidly from the 1880s (e.g. Henriksen, 1993; Nielsen, 2012; Østergård, 1992; Bjørn, 1971; Klitmøller, 2008).

3. Description of the Sources

Primary education

There are copious archival sources in the Danish National Archives on primary education, but, in contrast to the sources for secondary and tertiary education detailed below, little published material before the mid-nineteenth century, and even then, these are only sporadic. A detailed summary of the information available is beyond the scope of the present work, but the following presents an overview of the sources we are aware of.

The introduction of compulsory primary education in 1739 was preceded by the formation of a Royal Commission of January 18, 1737. Reports appear to have been collected from across the country⁸ including varying amount of detail, sometimes including for example floorplans. We found a particularly detailed report⁹ from the archives of the Diocese of Zealand (the island which includes the city of Copenhagen), which provides beautifully handwritten tables of the following, apparently for all schools in the diocese:

1. Location of the school (county, district, parish, town)
2. Type of school
3. Information about the school building
4. Year of foundation
5. Salary (presumably for the schoolmaster)
6. Schoolmaster's name and educational background.

Then, another Royal Commission of May 22, 1789 was to consider the school system and has also left behind copious archives¹⁰ which appear to include reports from all parts of the country, but are not particularly systematized. Statistics Denmark published a short piece on this in 1910¹¹, where they explain that they have in their archives a handwritten overview of schools in the countryside in 1790, left as part of the preparatory work for the new school law of 1814 (which was presumably delayed due to the outbreak of the French and Napoleonic Wars). They explain that the commission reported on 1,709 schools in the countryside¹², and that for the Dioceses of Zealand and Aarhus information is also given on how many schools would be required if no child should have more than a quarter of a Danish mile (of around 7 imperial miles / 11 km) to school, and on how easy it was to get to school (for example if the road was impassable in the winter). We have unfortunately not been able to find this report, but it seems likely it forms part of the archives of the Royal Commission which are available in the Danish National Archives.¹³

⁸ *Skolevæsenet på Landet: Kgl. kommissorium 18. jan. 1737 (1735-1737) F10-1; Skolevæsenet på Landet: Kgl. reskripter og korrespondance (1737-1745) F10-2-1; Skolevæsenet på Landet: Kgl. reskripter og korrespondance (1737-1745) F10-2-2; Skolevæsenet på Landet: Kgl. resolutioner og reskripter m.m. (1737-1741) F10-3.*

⁹ *Sjællands Stifts Bispeembede: Breve vedr. Frederiksborg Latinske Skole m.m. (1630-1747) B.3-457: 1630 - 1747 mm.*

¹⁰ *Kommission 22.05.1789: Det almindelige Skolevæsen: Deliberation over forslag t. forord. om skolevæsenet (1787-1803) F11-4-1; Kommission 22.05.1789: Det almindelige Skolevæsen: Deliberation over forslag t. forord. om skolevæsenet (1787-1803) F11-4-2; Kommission 22.05.1789: Det almindelige Skolevæsen: Besvarelser, kancellicirkulære 14.11.1789 (1789-1790) F11-1; Kommission 22.05.1789: Det almindelige Skolevæsen: Diverse (1790-1812) F11-5-1.*

¹¹ Statistics Denmark (1910), *Landbyskolerne i 1790, Statistiske Efterretninger* no. 9, p. 32.

¹² Although Larsen (1984) considers this to be an underestimate.

¹³ And at present inaccessible due to COVID-19 restrictions.

The new school laws of 1806 and 1814, which established improved municipal primary schools and independent schools in the countryside, provided for the collection of a wealth of additional data: in principle, annual reports on every primary school, which follow a similar although more detailed format to that collected by the Royal Commission of 1737. Many, although not all, have survived¹⁴, and include for every school in each county information on:

1. Parish
2. School name
3. Teachers, name, age and whether they had received formal training
4. Teachers, ability and condition
5. Total boys
6. Total girls
7. The general progress of the students
8. Whether the Monitorial System¹⁵ is practiced
9. Whether separate teaching is given in geography, and the history of the fatherland, and whether spelling, reading of handwriting and written exercises are practiced
10. Whether textbooks and other equipment is sufficient
11. On the condition of schooling, and what, where it is neglected, has been done to improve this
12. Whether there are winter schools for the confirmed youth
13. Whether the schoolrooms and the teachers' residences are in a sufficient state of arrangement
14. Whether the municipality has incurred debt in connection with the school system, and how this is repaid
15. Remarks

Importantly for the present study, they also include lists of grades by school for individual students, giving in one report for 1839-40:

1. Full name of student
2. Age of student
3. Average grade from the previous exam

¹⁴ *Årlige indberetninger ang. almueskolevæsenet i købstæderne og på landet (1811 - 1848)*, Danske Kancelli, Fællesafdelingen *Årlige indberetninger ang. Almueskolevæsenet*, S16-651, S16-652, S16-653, S16-654, S16-655. See also *Sjællands Stifts Bispeembede: Breve vedr. Frederiksborg Latinske Skole m.m. (1630-1747) B.3-457: 1630 - 1747 mm.*

¹⁵ A method independently invented by the British educators Andrew Bell and Joseph Lancaster based on the idea that abler pupils should assist the teacher.

4. Individual grades for individual subjects (with additional detail for various aspects of those subjects):
 - a) Religion
 - b) Orthography
 - c) Reading
 - d) Bible history
 - e) Reading of handwriting
 - f) Spelling
 - g) Mathematics
 - h) "Useful knowledge" (geography, history, nature)
 - i) "Skills" (singing, exercise)
 - j) "From the diary" (presumably the notes of the teacher: diligence, condition)
5. Average grade expressed as a number and in words, e.g. "very good"
6. Whether they have left the school

Digitizing this mostly handwritten, archival information would constitute a considerable challenge, but would present fascinating opportunities to consider the relationship between school/teacher quality and educational outputs over the very long run. Our ongoing digitization work has, however, focused on the more accessible sources for secondary and tertiary education, which we turn to next.

Secondary education

The sources available for secondary education reflect the fact that the university entrance exam was at first administered by the University of Copenhagen, but later by the high schools themselves. Thus, lists of grades for each student and for each subject were published first in the University of Copenhagen annuals (which include a range of other fascinating information), and subsequently in independent tabulations.¹⁶ We are currently digitizing the entirety of this information, as discussed in a little more detail below. Based on these sources, table 1 shows the standard range of exams which Danish high school graduates were to complete in order to qualify for admission to university. The earliest records we have found date from 1805, with grades available up to 1884. Subjects on which students were assessed include classical languages (Greek, Hebrew and Latin — the latter with

¹⁶ *Aar bog for Kjøbenhavns Universitet, den polytekniske Lærestalt og Kommunitet, Meddelser for de akademiske Aar [1837-1915] med Sagsregister (1837-1915)*. Copenhagen; *Aarlige Lister over Dimittenderne til Examen Artium fra 1805-1852*. Copenhagen; *Fortegnelse over de ... Studerende, der i [1853-1920] have tilendebragt Afgangseksamen ved de lærde Skoler eller Adgangseksamen ved Universitetet*. Copenhagen.

separate oral and written exams), modern languages (Danish, French and German), religion, geography, history, arithmetic and geometry. The range of disciplines remained unchanged until the mid-nineteenth century.

From 1850, the university-administered entrance exam was handed over to individual schools to administer (Danish Ministry of Education 1998). The records available from 1853 reflect this change, with the university's grading structure (using Latin phrases such as *laudabilis*) replaced by the Ørsted grading scale (named after the famous physicist, H.C. Ørsted) used by schools, where grade levels translated to marks (from -23 for the lowest fail grade to +8 for the highest grade) that could then be used to calculate an average (Grading Commission 2004).¹⁷

¹⁷ The Ørsted scale also appears earlier in the records, from 1805 to 1817. In 1818, the Latin grading scale was applied to assessment of the *artium* admission exam, surviving until 1853. From 1845, selected schools began to administer separate graduation exams (on level footing with the university's *artium*) where the Ørsted scale was applied.

Table 1: Overview of grades available from Danish high school graduate exams, 1805–1884

	Subjects examined as of:			
	1805	1850	1864	1871
Danish	Y	Y	Y	Y
German	Y	Y		Y
French	Y	Y		Y
English				Y
Old Norse				Y
Latin	Y	Y	Y	Y*
Greek	Y	Y	Y	Y*
Hebrew	Y	Y	Y	
Religion	Y	Y		
Geography	Y	Y		
History	Y	Y	Y	Y
Arithmetic	Y	Y	Y	Y**
Geometry	Y	Y	Y	Y**
Natural history		Y		
Physics and chemistry (<i>naturlære</i>)		Y	Y	Y*
Mechanical physics				Y**
Chemical physics				Y**

Notes: 1) Students who started their exams prior to the introduction of curriculum changes would continue to sit exams under the old system. Thus, exam results for some subjects continue to appear after their notional discontinuation. 2) For some subjects, results are separately reported for written and oral exams. 3) * Linguistic-historical stream, ** Mathematical-scientific stream.

With the switch to school-administered graduation exams, the range of examined subjects expanded to include the natural sciences: physics and chemistry (*naturlære*) and natural history (geology, zoology and botany). Further changes were introduced in 1864 which reduced the number of assessed subjects: under the new system, students were only examined in Danish (with two separate tasks), Latin (oral and written), Greek, history, arithmetic, geometry and physics/chemistry.¹⁸ A small number of students, presumably mostly Jews, continued to sit exams in Hebrew.

¹⁸ Some students who had commenced exams before the end of 1864 continued to sit the old system of exams through until 1870. Icelandic students seeking admission to the University of Copenhagen also continued to sit the old exams, with an additional exam in Icelandic.

As noted above, different study pathways were introduced in 1871, enabling students to specialize in (and be assessed on) either linguistic-historical or mathematical-scientific studies. All students were required to study Danish, a new exam on Old Norse, two of three modern languages (English, French or German), and history. Students in the linguistic-historical stream would sit three exams in Latin (one written, two oral), as well as exams in Greek and a natural science subject. Students in the mathematical-scientific stream would complete oral and written exams in both arithmetic and geometry, as well as exams in mechanical physics (including optics) and chemical physics (including astronomy and meteorology).

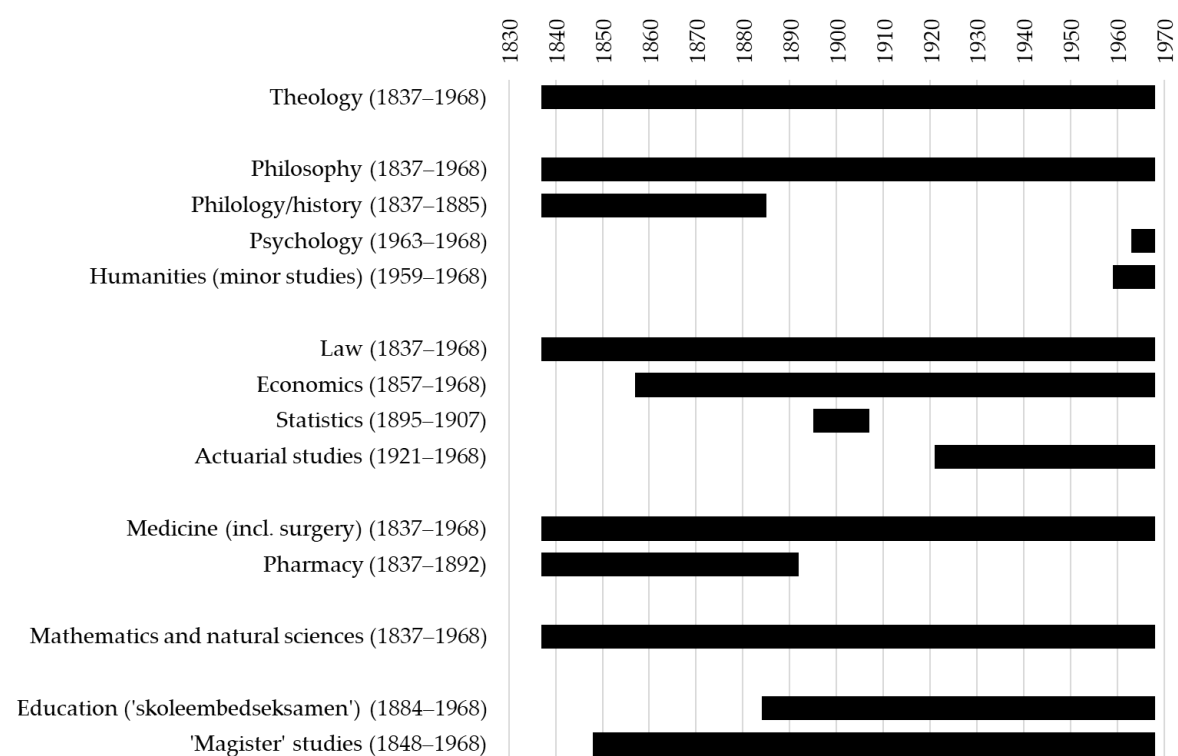
From 1884, the individual grades for graduates' exams were no longer reported by the university — only each graduate's overall grade. From the records currently available to us, we have identified these overall grades for high school graduates up to (and including) 1915.

Tertiary education

Figure 1 provides an overview of the courses at the University of Copenhagen for which grades are available from 1837 onwards. The earliest records available include grades in theology, law, medicine (including surgery and pharmacy), philosophy, polytechnics (applied natural sciences), and philology/history (classical languages such as Hebrew and Latin, geography and history). Students were assessed on both theoretical and practical elements, and completed both written and oral exams.¹⁹

¹⁹ In contrast to examination practices in many other countries, oral examinations — where students answer questions from examiners in a face-to-face format — remain a standard assessment tool in Danish high schools and, to a lesser extent, universities today.

Figure 1: Overview of grades available from exams at the University of Copenhagen, 1837–1968



Notes: 1) Records available for the years 1837–1842, 1844–1848, 1857–1915, 1920–1968 (inclusive). 2) Most of the courses included several units (subjects) with both practical and theoretical exams. From the 1920s, only the student's final course grade is published — not results of individual units. 3) From 1969, only name, date of birth and (in some cases) study program are recorded. Grades are not published.

There were a limited number of changes in the university's course offerings through the nineteenth century. The faculty of law expanded to include economics in 1848 (University of Copenhagen 2019a): exams were introduced in economics (with the first available grades in 1857) and statistics (1895). In the other direction, the final examination for philology/history was conducted in 1885. The philology/history exam had been a requirement for high school teachers, but in 1883, a new broader education exam was introduced (*skoleembedseksamen*), with a focus on modern languages and natural sciences over classical languages (University of Copenhagen 2019b). Pharmaceutical studies ceased at the University of Copenhagen with the establishment of the Pharmaceutical College in 1892 (University of Copenhagen 2019a).

A significant change was the introduction of magister studies in 1848. The magister degree was a research-oriented qualification, allowing students to study fields outside the established disciplines — thus enabling the university's scope of education and research to expand over time. The degree was conferred following an individualized exam (*magisterkonferensen*) tailored to the student's studies. Details of magister examinations at the University of Copenhagen are available from 1857, including descriptions of each student's studies and research. The magister degree was eventually replaced by PhD studies from the late twentieth century — phased out first in the natural sciences in 1978, and finally in the humanities in 2007 (University of Copenhagen 2018).

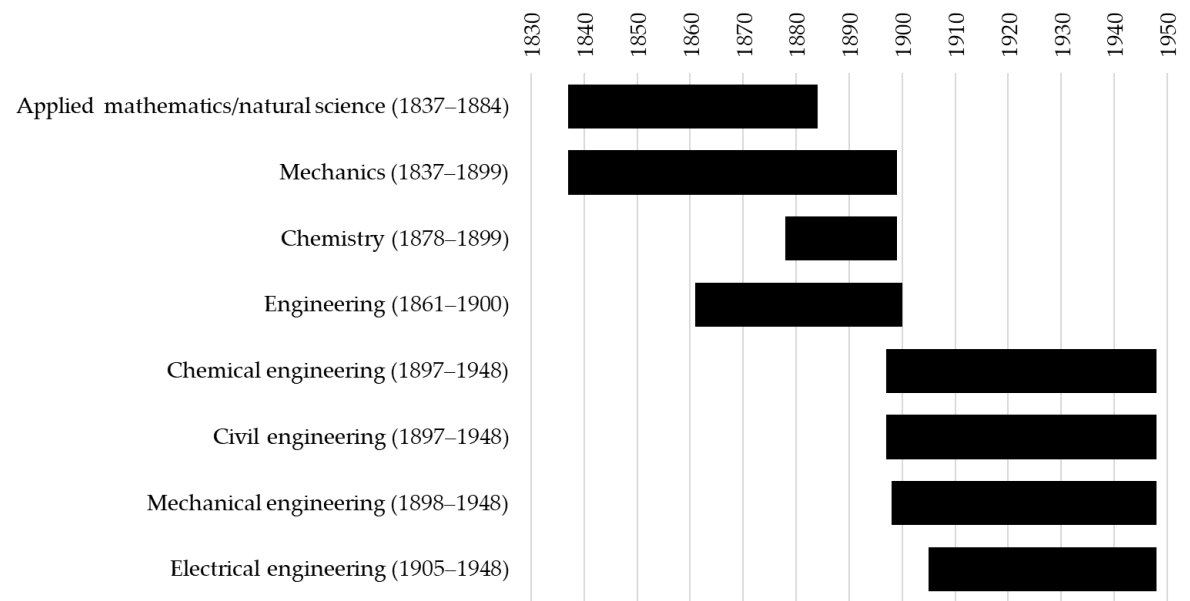
The last year for which individual grades for Copenhagen's graduates were reported is the 1967-68 academic year. Thereafter, graduate names are reported (grouped by faculty), along with summary statistics of the overall cohort. Nevertheless, from around that time grades (at all levels of education) as well as many other things began to be recorded in centralized register data.

Figure 2 outlines the history of programs at what is now the Technical University of Denmark, with the earliest records available from 1837. The initial courses were in the fields of applied mathematics and natural sciences as well as mechanics. Later, both engineering and chemistry²⁰ were included (with their exams first reported in 1861 and 1878 respectively). By the end of the twentieth century, courses were reclassified as sub-fields of engineering. In 1897, the first exam results were recorded in chemical engineering and civil engineering. These were joined by the first exams for mechanical engineering in 1898, and electrical engineering in 1905 (Technical University of Denmark 2017).

Students' individual exam grades were reported until 1920. From the 1920-21 academic year, only students' overall grade upon completion of studies is reported. The final year for which we have records of student grades is 1948.

²⁰ An assessment in chemistry had been reported in the records as far back as 1871, in connection with an architecture exam — though without any details of grades.

Figure 2: Overview of grades available from exams at the Technical University of Denmark, 1837–1948



4. Conclusion and Suggestions for Applications

Having located the sources of the grades, the next step is to construct a database, and this process is currently ongoing using expertise at the University of Southern Denmark, employing state-of-the-art machine learning models for automatically extracting and correcting text and a powerful server funded by the Carlsberg Foundation. As noted above, our focus at this time is on the printed sources for secondary and tertiary education. Once the data is read in, we will construct new individual level measures of human capital, both as an average measure, as well as decomposed into for example “knowledge of humanities”, and “knowledge of science”. The data will then be linked to existing census records, allowing for greater accessibility of the data, since it will be available through the online platform of LINK-LIVES, a project which is digitizing the censuses. Finally, we plan to supplement this with information from student biographies, based on a Danish (and Norwegian) tradition of publishing books commemorating (usually) the 25th and 50th anniversary of graduation, and including information on the full career of whole cohorts of graduates, including positions, travels, publications, and more. These will allow us to go beyond the formal education aspect of human capital, and the sources’ use for agriculture has already been discussed by Ranestad (2021).

We believe that the full database will be of interest to a wide variety of scholars. For our part, we aim to consider the broad question of the role of human capital for economic development, and specifically, to mention a few examples, its role for the demographic transition, whereby fertility fell as investments in human capital increased (see e.g. Angrist et al 2010; Klemp and Weisdorf 2015; Clark and Cummins 2016; Fernihough 2016); for health (see e.g. Conti et al 2012; Fischer et al 2013; Bleakley et al 2014; Bailey et al 2015; Parman 2015), and for migration (see e.g. Abramitzky et al 2012). We would also be able to measure educational mobility (see e.g. Clark and Cummins 2014). We will not be the first to consider these questions, but we would be the first to have a truly meaningful and detailed measure of human capital for a period of over a century. The questions that might be answered are at the core of economics and economic history and are certainly only the beginning of an exciting new research agenda using broader and more detailed measures of human capital.

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