



Transforming and Financing Intermediate-Level Technical Education During Industrialisation: Sweden 1850–1920

Fay Lundh Nilsson & Niclas Blomberg

Abstract • Around 1900, Sweden had transformed into a modern industrial nation. A three-level technical school system, introduced in the 1850s, ensured that Sweden maintained a strong position among other industrialised countries. In this article, we study changes in the structure and financing of the technical secondary schools, the middle level of the system, between 1850 and 1919. Both local and national actors were important in the structural changes and educational reforms, but government grants remained the same for extended periods, which led to frequent discussions and pleas for increased funding. Low salaries compared to other forms of schooling and competition from the industry gradually became a problem recruiting qualified teachers. However, stakeholders who considered the education of middle-level technicians an important matter pushed for increased funding, improvements in teachers' salaries and employment conditions, and restructuring of the teaching to keep pace with technological development.

Keywords • Industrialisation, technical education, financing of education, educational reforms

Introduction

It is not only the engineer, the designer, the director of large industrial companies, who for his business must seek light and guidance in the instructions of science. Those who are to lead these enterprises at all different levels are in need of it: yes, even the deepest ranks of the numerous industrial classes can benefit from the applications of science and art for their work.¹

The mid-nineteenth century is regarded as the beginning of a period of radical economic and societal development in Sweden. At this time, agriculture was still dominant, though mining was also being practised successfully. In the ensuing decades, Swedish economic development benefited from strong demand for export goods, mainly raw materials and simpler industrial products, as other countries increased their investments in railways, industries, and housing. The sawmill industry, for example, gained an early rapid boost thanks to international demand.

Over the course of a few decades thereafter, industrialisation, urbanisation, and modernisation took off and, at the beginning of the twentieth century, Sweden was an established and successful industrial country with an internationally acclaimed

¹ SOU 1876:7, *Underdånigt betänkande och förslag angående den lägre tekniska undervisningen i riket* (Stockholm: Ivar Häggströms boktryckeri, 1874), 3. Authors' translation.

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mechanical engineering industry. What made this development possible? As in many other European countries, railway construction had gained momentum, new processes in steel production had been innovated, and extensive institutional changes had been implemented during the latter half of the nineteenth century. Liberalisation of national markets, as well as increased mobility between countries, also contributed to the rapid transformation.²

Around 1850, Swedish higher technical education was almost on par with Europe's leading technological institutions. The Technological Institute (*Teknologiska Institutet*)—from 1877 the Royal Institute of Technology (*Kungliga Tekniska Högskolan*)—in Stockholm trained mainly engineers for the large-scale industry and public administration. The craft sector, as well as local and regional-based small and medium-sized industries lacked technically skilled personnel;³ not only foremen but also people in higher positions mainly received their education through years of practical training at the workplace.⁴ Thus, it became clear that a successful technological development required a new technical-education level. Thanks to a proposal from the principal of the Technological Institute, Lars Johan Wallmark, four technical secondary schools—the focus of this article—modelled after the German *Gewerbeschulen*,⁵ were established in the mid-1850s in Malmö, Norrköping, Borås and Örebro. Thus, a complete technical-education system was created with the existing technical Sunday and evening schools as the lower level, the technical secondary schools as the intermediate level, and the Technological Institute as the higher-level education.⁶

The firm belief in technology's blessings during the latter half of the nineteenth century became part of the political goal of ensuring Sweden had a position in the race towards modernity and industrialism. Thus, the technical secondary schools became part of a much larger plan that came to affect their development over time, both in terms of the content of the teaching and the financing of the schools. Although the technical secondary schools have been the subject of previous attention as technical educational institutions, the issue of funding has not been addressed before.⁷ In this article, we study how the establishment of the technical schools was initially financed and how the interplay between subsequent reforms and financing developed over time.

2 Lennart Schön, *En modern svensk ekonomisk historia: Tillväxt och omvandling under två sekel* (Lund: Studentlitteratur, 2014); Thor Berger and Kerstin Enflo, "Locomotives of local growth: The short and long-term impact of railroads in Sweden," *Journal of Urban Economics*, no. 98 (2017), 124–38.

3 Göran Ahlström, "Technical Education, Engineering and Industrial Growth: Sweden in the Nineteenth and Early Twentieth Century," in *Education, Technology, and Industrial Performance in Europe, 1850–1939*, ed. Robert Fox and Anna Guagnini (Cambridge: Cambridge University Press, 1993), 115–40.

4 Fay Lundh Nilsson, "Sågverksindustrin och utbildningsfrågorna," in *Sågad skog för välstånd: Den svenska sågverksindustrins historia 1850–2010*, ed. Ronny Pettersson (Stockholm: Kungl. Skogs- och Lantbruksakademien, 2015), 418–19.

5 Lars-Johan Wallmark, *Om tekniska elementar-skolors inträttande i Sverige* (Stockholm, 1851).

6 Chalmers (*Chalmerska Slöjdskolan*), established in 1829, was already in the 1850s an exception. Wallmark saw Chalmers as one of the better so-called handicraft schools, which could become one of the planned technical secondary schools. However, Chalmers gradually developed towards a level just below the Institute of Technology. See: Rolf Torstendahl, *Teknologins nytta: Motiveringar för det svenska tekniska utbildningsväsendets framväxt framförda av riksdagsmän och utbildningsadministratörer 1810–1870* (Uppsala/Stockholm: Almqvist & Wiksell, 1975), 171, 181, 184.

7 Ahlström (1993).

The remainder of the article is arranged as follows. First, we provide a background of previous research, followed by our research questions and an introduction of our sources and data. This is followed by a section on the funding of the establishment and the early years of the technical secondary schools. The following two sections deal with two major reforms and their financing. The article ends with an analysis of the interaction between reforms and funding.

Background and previous research

Researchers have long been interested in whether there is a connection between technological and organisational development of production and occupational skills in the workforce. According to, for example, Claudia Goldin and Lawrence F. Katz, skilled or more educated labour is more complementary with new technology or physical capital than is unskilled or less-educated labour.⁸

However, it can be argued that such a general reasoning is based on the premise of the average worker. In recent years, attention has been paid to defining different kinds of human capital and its usefulness during periods of industrial development. Research has so far brought forth interesting new results. Of particular interest to the present article are the studies that deal with *upper-tail knowledge* and *intermediate human capital*.

The role of different levels of technical knowledge

The term upper-tail knowledge was first used in 2005 by Joel Mokyr⁹ and appeared again some years later in an article by Mokyr and Voth, who argued that "... the Industrial Revolution was carried not by the skills of the average or modal worker, but by the ingenuity and technical ability of a minority."¹⁰ The term has subsequently been used by several researchers. For example, Maria P. Squicciarini and Nico Voigtländer distinguish between average human capital and upper-tail knowledge, the latter embodied in the presence of "knowledge elites."¹¹ Claude Diebolt, Charlotte Le Chapelain, and Audrey Rose Menard also refer to Mokyr's idea that human capital may consist of several different parts and that these can be combined in different ways. Thus, a specific combination may prove "useful" for economic growth, while other kinds of human capital do not contribute to economic development.¹² Of particular relevance to the present article is their use of the term intermediate human capital. The term is defined as "intermediate skills formed by the diffusion of basic general knowledge that goes beyond basic literacy and numeracy skills."¹³

8 Claudia Goldin and Lawrence F. Katz, *The Race between Education and Technology* (Cambridge: The Belknap Press of Harvard University Press, 2009), 93–94.

9 Joel Mokyr, "Long-Term Economic Growth and the History of Technology," in *Handbook of Economic Growth*, vol. 1, ed. P. Aghion and S. Durlauf (Amsterdam: Elsevier, 2005), 1113–80.

10 Joel Mokyr and Hans-Joachim Voth, "Understanding Growth in Early Modern Europe," in *The Cambridge Economic History of Europe*, ed. Stephen Broadberry and Kevin O'Rourke (Cambridge: Cambridge University Press, 2009), 35.

11 Maria P. Squicciarini and Nico Voigtländer, "Human Capital and Industrialization: Evidence from the Age of Enlightenment," *The Quarterly Journal of Economics* 130, no. 4 (2015), 1877–78.

12 Claude Diebolt, Charlotte Le Chapelain, and Audrey Rose Menard, "Neither the Elite, nor the Mass: The Rise of Intermediate Human Capital during the French Industrialization Process," *Cliometrica* no. 15 (2021), 168.

13 Diebolt, Le Chapelain, and Menard (2021), 169.

It differs from specific vocational skills by not targeting any specific occupation; instead, it consists of general knowledge in basic scientific and technical subjects, foreign languages, law, and trade. Thus, it also differs from scientific knowledge that only occurs in an intellectual elite.¹⁴

Technology transfer

The Swedish state's interest in investing in technical education in the early nineteenth century originated in two different lines of argument: the need for more people to engage in productive occupations in the industry, followed by higher social mobility, and the need to create an internationally competitive Swedish industry.¹⁵

The subsequent emergence of a technically knowledgeable Swedish workforce for the industry can be seen as a two-step process in which international influence played a determining role. The first step involved technology transfer via technically interested agents directly to the industry. The second step concerned building and institutionalising technical education inspired by the teaching models of more developed countries.

Technical knowledge is not only disseminated through institutions, but also through “immaterial matters, such as ideologies, knowledge, and opinions” carried by agents such as individuals, newspapers, and journals. However, for a successful transfer to take place, there must be a positive cultural climate and a sufficient level of knowledge.¹⁶ In the case of Sweden, both prerequisites seem to have existed in the early 1900s. Even before the introduction of compulsory elementary schooling in 1842, the majority of the Swedish population was partially literate, which was an effect of the Church Act of 1686, which stipulated that every adult Swede should be able to read the most important religious texts. Although the general level of education of the population was low, this partial literacy provided a cultural breeding ground for the interest in education in general. As we will see later on, on an individual level, Lars Johan Wallmark's proposal in the 1850s for the establishment of technical secondary schools was strongly inspired by his personal contacts in Germany, as was the work of later reformists.

Personal contacts and an industrial culture also played significant roles in the localisation of the technical secondary schools in the early 1850s. Strong local industrialists and other prominent people with well-developed connections with representatives in parliament were important for the final decisions on the localisation of the four technical secondary schools.¹⁷

Another inflow of technical knowledge became common in the late nineteenth century when educated Swedish technicians brought back knowledge to Sweden.

¹⁴ Ibid.

¹⁵ Torstendahl (1975), 202–44.

¹⁶ Karl Gunnar Hammarlund and Tomas Nilson, “Technology in Time, Space, and Mind: An Introduction,” in *Technology in Time, Space, and Mind: Aspects of Technology Transfer and Diffusion*, ed. Karl Gunnar Hammarlund and Tomas Nilson (Göteborg: Forskning i Halmstad 13, 2008), 10–11. See also: Lars G. Sandberg, “The Case of the Impoverished Sophisticate: Human Capital and Swedish Economic Growth before World War I,” *The Journal of Economic History*, vol. 39 (1979), 225–41.

¹⁷ Fay Lundh Nilsson and Per-Olof Grönberg, “Inget för de lärde? Diskussionerna om lokaliseringen av de tekniska elementarskolorna i Sverige i mitten av 1800-talet,” *Historisk Tidskrift* 139, no. 2 (2019), 251–81.

This could be done in two ways. The first was through engineers, who after several years of study at world-leading polytechnical schools, mainly in German-speaking countries, returned to Sweden. The second was through engineers who had studied in Sweden but found jobs in countries such as Germany and the United States, especially within the mechanical, electrical, and chemical industries.¹⁸ As recent research shows, graduates from the technical secondary schools also went abroad for further study and some years of work.¹⁹

Financing of education

In addition to the large literature on human capital and its relation to industrialisation processes, there is a large and growing literature on education and its effects on society. Part of this literature is historical, dealing with the experiences of various countries with respect to the rise of mass education during the period of industrialisation. However, the literature focusing on the history of how these great undertakings were financed remains relatively scarce.²⁰ Scarcer still is historical literature on the funding of technical education.

In the case of Sweden, local taxes levied in-kind were essential to the early growth of the primary school (*folkskolan*) in the 1840s and onwards, making schooling affordable when monetary means were not readily available locally.²¹ Teachers' wages were not always sufficient and there is evidence that the rural teachers often were engaged in a livelihood diversification.²² The point of livelihood diversification is also interesting from a technical education point of view, as many primary school teachers were also engaged in the so-called technical Sunday and evening schools that were established in small numbers from the early nineteenth century.²³ Around 1850, there were nine such schools, often labelled as handicraft schools (*slöjdskolor*).²⁴

Another study that deals with educational finance is Peter Lindert's *Growing Public*. Lindert argues that, in contrast to traditional theories on the expansion of mass education that often emphasise elite self-interest, other explanatory factors, such as decentralisation and democratisation, allowed local governments to decide auton-

18 Per-Olof Grönberg, *The Peregrine Profession: Transnational Mobility of Nordic Engineers and Architects, 1880–1930* (Leiden/Boston: Brill).

19 Fay Lundh Nilsson and Per-Olof Grönberg, "A Technical Workforce for Regional Industrial Development? Origin and Dispersion of Graduates from the Technical Secondary Schools in Malmö and Borås 1855–1930," *Scandinavian Economic History Review* (2021). Published online: 01 April 2021.

20 Anne Berg et al., "Introduction: The History of Educational Finance," *Nordic Journal of Educational History* 2, no. 1 (2015), 3–22.

21 Johannes Westberg, "When Teachers Were Farmers: Teachers' Allotted Farms and the Funding of Mass Schooling, 1838–1900," *Nordic Journal of Educational History* 2, no. 1 (2015), 4–22; Johannes Westberg, "Making Mass Schooling Affordable: In-kind Taxation and the Establishment of an Elementary School System in Sweden, 1840–1970," *Pedagogica Historica* 52, no. 4 (2016), 349–63.

22 Johannes Westberg, "How Did Teachers Make a Living? The Teacher Occupation, Livelihood Diversification and the Rise of Mass Schooling in Nineteenth-Century Sweden," *History of Education* 48, no. 1 (2018), 19–40.

23 Lars Larsson, *Industri- och hantverksutbildning under två sekler*, Föreningen för svensk undervisningshistoria, volume 194 (Uppsala: Universitetstryckeriet, 2001); Per Hartman and Sven Hartman, "Hantverksskolning eller karaktärsfostran? Den slöjdpedagogiska debatten i Sverige under 1800-talets senare hälft," *Techne* 25, no. 2 (2018), 4.

24 Brita Wernlund, *Några drag i den svenska yrkesutbildningens utveckling* (Stockholm: Author, 1965), 21–73.

omously on matters of educational spending without interference from the central government.²⁵

The Industrial Revolution might have been driven by a minority in possession of upper-tail knowledge, as Mokyr argued, but in order to operate and maintain the means of production that these elites invent, a much larger labour force with many different types of skills is required. The emergence of the technical secondary schools can be seen as a recognition of this—albeit possibly unconsciously—by the industrialists, educationalists, and politicians at the time. When it comes to the financing of technical education, especially during the early years, the research is rather fragmented. Anders Hedman devotes a few pages to the subject in his treatment of technical (vocational) education reforms in the 20th century, but his exposition of financial matters does not extend to the 19th century.²⁶ Similarly, although the work of Lennart Nilsson contains several references to financial matters, his main focal point is not the financing of technical education and his treatment is largely constrained to what is already contained in the government reports.²⁷

Although the financing of Swedish technical education is mentioned in a plurality of places, it is always fragmented and is never the focus of attention, but brought in by authors as a part of a different narrative. Thus, more systematic studies are needed to form a more complete picture. One important lesson that we draw from the emerging body of research into educational finance is that *finance* does not simply mean money. Rather, it should be thought of as pertaining to funding—who is funding, for what reasons and under what circumstances. For instance, how the 19th century primary school teachers lived is a part of this conceptualisation of financing. Thus, the study of educational finance requires that we study broadly the overarching societal and institutional context. For this reason, the article will also focus on reforms and legislation.

Research questions

As is evident from the literature review above, the financing of the technical secondary schools should be seen in a larger perspective. The state's early interest in productive activities and international competition, the elite's self-interests, the industry's demand for technical knowledge, and the local communities all played different but significant roles during 70 years of financing the technical secondary schools. In this article, we explore various aspects of the funding of these schools.

Firstly, we examine the financing of the technical secondary schools from the establishment in the 1850s, during the reform periods in the 1870s and the late nineteenth century until the end of the school form in 1920. We ask the following questions:

- What role did the state, municipalities, and private financiers play in the establishment of the technical secondary schools in the 1850s and did the relationship between the financiers change over time?

25 Peter Lindert, *Growing Public*, vol. 1 (Cambridge: Cambridge University Press, 2004), Chapter 5.

26 Anders Hedman, *I nationens och det praktiska livets tjänst: Det svenska yrkesutbildningssystemets tillkomst och utveckling 1918 till 1940* (Umeå: Pedagogiska institutionen, Umeå universitet, 2001).

27 Lennart Nilsson, *Yrkesutbildning i nutidshistoriskt perspektiv* (Göteborg: Acta Universalis Gothenburgensis, 1981).

- Did changes in the schools' teaching/teaching assignments, due to the official reports in the 1870s and early twentieth century, involve increased financial commitments from the state, the local community, and other financiers?

Secondly, in the 1850s the technical secondary schools were an entirely new type of schooling on a new intermediate level between the existing Sunday and evening schools and the Technological Institute. Therefore, we ask the following question:

- What conclusions can be drawn regarding the technical secondary schools' status and significance as seen from stakeholders in industry and the government?

Thirdly, an important issue that came up in the discussions about the establishment of technical secondary schools was the availability of teachers. The cities of learning, which wanted but did not get technical secondary schools, used the availability of teachers as an argument for choosing these cities. Despite the shortcomings of other cities in terms of the supply of teachers, the parliament chose to establish the first four schools where there was already a somewhat developed industrial activity.²⁸ Here, we ask the following question:

- To what extent did the necessity of being able to recruit qualified teachers influence the reforms concerning teachers' wages?

Definitions and limitations

When the technical secondary schools were introduced, and up to the beginning of the twentieth century, only two educational levels were used in the official reports on technical education. According to this system, the technical secondary schools were regarded as lower technical education institutions. In this article, we prefer to use the term intermediate technical education, which Diebolt et al. define as "Basic scientific and technical knowledge (linear drawing, geometry and mechanics, chemistry and physics, mathematics, marine and hydrography) ...".²⁹ We do so because the division into three levels better reflects the purpose of Wallmark's comprehensive technical education system.

Our exploration of these schools has certain limitations. Concerning the detailed financing of the technical secondary schools on the central level, we have, within the framework of the resources available to us, chosen to focus on the government grants and the teachers' wages. On the local level, we take a closer look at the school in Malmö, supplementing this with material from the other schools.

Sources and data

The rapid development of the natural sciences and the subsequent technical application of new scientific findings gradually led to a more or less acute need for a revision of the entire technical education field in the 1870s. The first official report, published in 1873, considered higher technical education. The appointed committee examined the extent to which other independent technical schools could be merged with the

28 Lundh Nilsson and Grönberg (2019), 265–66, 270, 274.

29 Diebolt, Le Chapelain, and Menard (2021), 169.

Technological Institute.³⁰ This report was the starting point for a broader review of Swedish technical education. The committee's discussions about scientific and technological development and its detailed comparisons with other countries' technical education also formed the background for the next inquiry, which dealt with the lower technical education, including the technical secondary schools.³¹ This report was published and sent out for expert opinion in 1874.³² The report, as well as the comments sent to the committee from the schools, are invaluable for understanding what had become of Wallmark's proposal. A new investigation was initiated in 1907 and led to the publication of two official reports in 1911 and 1912.³³ These reports present a broad overview of the results of the first reform and a detailed description of the background and proposed implementation of the successor of the technical secondary school—the specialised technical school (*fackskolan*).

Financing

The official reports also contain some discussions about financial matters, including some details that are hard to find elsewhere. However, when it comes to the financing of the schools, the most important source is the reports of the national accountants (*Riksdagens revisorerers berättelse*).³⁴

The Swedish parliament recently underwent a process of digitalisation in which older documents from 1521 to 1970 were made available online. Available material includes propositions, motions, minutes, and committee reports. Currently, only the period from 1867 is searchable via the parliament's home page. From these reports we can obtain a yearly view into the finances of the technical secondary schools, which enables us to see how income, expenses, and government grants changed over time. However, the data have a few limitations. Firstly, the reports only appear yearly after 1866—the year when the bicameral parliament replaced the estates. Secondly, there is a tendency for the categories used in the reports to change from time to time. This makes a detailed comparison along the temporal dimension difficult for all but some areas, such as wages. Thirdly, it seems that the schools did not always report other income sources to the parliament; comparisons with the other main source, the accounting books from the school in Malmö, covering the period 1855–1876, show, for example, that interest from certain funds was not reported.

We should also mention the choice of monetary units used in this article. The Swedish currency system in the 19th century was quite complex, with five different *riksdaler* in addition to a few other currencies.³⁵ Until 1873, *riksdaler*, *riksdaler*

30 SOU 1874:2, *Underdånigt betänkande och förslag angående åtskilliga läroverks förening med Teknologiska Institutet och bildandet av en Teknisk Högskola* (Stockholm: Ivar Haggströms boktryckeri, 1873).

31 SOU 1876:7, *Underdånigt betänkande och förslag angående den lägre tekniska undervisningen i riket* (Stockholm: Ivar Haggströms boktryckeri, 1873).

32 According to the Swedish SOU-system used for official reports where reports are numbered after publication year, there seem to be an inconsequent numbering of this report.

33 SOU 1918:10, *Underdånigt utlåtande och förslag till den lägre tekniska undervisningens ordnande I* (Örebro: Länstidningens tryckeri, 1912); SOU 1918:10, *Underdånigt utlåtande och förslag till den lägre tekniska undervisningens ordnande II* (Örebro: Länstidningens tryckeri, 1911). Note that the first part was published after the second part.

34 See: <https://www.riksdagen.se/sv/dokument-lagar/hitta-aldre-riksdagstryck> (in Swedish).

35 Rodney Edvinsson, "Swedish Monetary Standards in Historical Perspective," *Stockholm Papers in*

banco, *riksdaler specie*, *riksdaler riksgälds*, *riksdaler riksmünt* were in use, with values changing over time. For instance, between 1855 and 1873, one *riksdaler* was defined as two-thirds of a *riksdaler banco*, one-fourth of a *riksdaler specie*, four *riksdaler riksgälds*, or one *riksdaler riksmünt*.³⁶ The system was consolidated after 1873 and in the new units one *krona* was equal to one *riksdaler*.

This diversity creates a problem when studying various points in time, especially since the units are sometimes mixed within the same source. In this article, we have decided to report monetary units as they are given in the sources, except when looking at changes over longer periods of time, in which case we have converted to *kronor* to make a comparison possible. Before 1873, we have taken the value of one *krona* to equal one *riksdaler* in order to enable us to make comparisons.

The government grants were divided into so-called ordinary and extraordinary grants, with the former accounting for the majority of the grants. The latter were changed three times—in 1856/58 a few years after the schools' inception, in 1876, and in 1905—but otherwise remained largely constant during the period of study. Thus, three subperiods can be identified here: the period until 1876, including the changes in the initial years; the period 1877 to 1905; and the period 1906 to 1919. Extraordinary grants were used for temporary expenses and were almost never allocated before the turn of the century, except for a short period in the 1870s in preparation for the first major reform.

The technical secondary schools

As director of the Technological Institute, Wallmark was well acquainted with the status of domestic technical education, but he had also studied the development of technical education in other European countries.³⁷ It was, above all, the German technical three-level education system that inspired Wallmark when he presented his ideas about a new type of school—the technical secondary school. The German system consisted of technical institutes/polytechnical schools at the higher level; technical secondary schools, including the *Gewerbeschulen*, at the intermediate level; and Sunday and evening schools at the lower level.³⁸ In Wallmark's proposal, as well as in later reform proposals, the *Gewerbeschulen* played an important role. Meyers' *Konversations-Lexikon* characterised the *Gewerbeschulen* as "Institutions in which the prior knowledge and the basics of professional knowledge for higher craftsmanship and the industry are taught."³⁹ The *Gewerbeschulen* were organised in close cooperation with industrial and trade organisations, which also handled the management and financing of the schools together with governmental official.

They also functioned as a preparation for higher-level technical education.⁴⁰ The already-existing German system for technical education and Wallmark's ideas for

Economic History, Department of Economic History, Stockholm University, no. 6 (2009): 26.

36 Calculations based on: Edvinsson (2009), 26.

37 Wallmark (1851), 5.

38 *Ibid.*, 16.

39 *Meyers Konversations-Lexikon* (Leipzig and Wien: Autorenkollektiv, Verlag des Bibliographischen Instituts, 1885–1892), search word "Gewerbeschule". Authors' translation.

40 Alexandra Semrad, "Modern Secondary Education and Economic Performance: The Introduction of the *Gewerbeschule* and *Realschule* in Nineteenth-century Bavaria," *Economic History Review* 68, no. 4 (2015), 1311–12.

a similar solution in Sweden fit well into recent research's distinctions on different types of human capital. For Sweden, Wallmark's proposal meant that the existing Sunday and evening schools and the new technical secondary schools would convey what Diebolt, Chapelain and Menard characterise as basic and intermediate human capital (see also Definitions and limitations), while the Institute of Technology would stand for what Squicciarini and Voigtländer, in the spirit of Mokyr and Voth, call upper-tail knowledge.⁴¹

Wallmark proposed Stockholm and Malmö as the first cities that should have a technical secondary school. The first proposition for the secondary technical schools in 1850/51 called for a yearly grant of 6,600 *riksdaler* to each of the proposed schools.⁴² The standing committee of supply (*statsutskottet*) was initially sceptical and recommended the four estates to reject the proposition—introducing yet another school with similar existing subjects was not seen as the best way to use the resources of the state.⁴³ However, three of the four estates in parliament submitted objections to this stance, with the Peasants (*bondeståndet*) being the only estate supporting it. It was generally felt that technical secondary school should give instruction in subjects not readily available in general schools, such as modelling, chemistry, physics, and accounting.⁴⁴ With three of the estates objecting, the standing committee of supply changed its stance, recommending the chambers to agree to the introduction of one school, with a yearly grant of 5,000 *riksdaler*, which was 1,600 *riksdaler* less than the initial proposal.

By comparison, a decade earlier the upper secondary school *Stockholm's Gymnasium* with five teachers had received a yearly government grant of 5,640 *riksdaler*.⁴⁵ In addition, the technical school in Eskilstuna received a government grant of 5,000 *riksdaler* in 1856/58 on the condition that the city covered costs for rent, heating, and furniture.⁴⁶ We can see that although there was some dissatisfaction with the size of the grants (see discussion below), it seems 5,000 *riksdaler* was not an uncommon grant in other schools as well.

In Stockholm, neither the city board nor the parliament showed any interest in financing such a school since they meant that they had enough of the costs for the existing handicraft school. The city of Malmö, on the other hand, had in 1850 applied for a state grant to start a school that would prepare for higher technical studies. Unlike Stockholm, Malmö was also willing to pay for teaching facilities. A fundraising drive preceding the application for a state grant had collected 3,125 *riksdaler banco* from 122 Malmö citizens, some of which were prominent manufacturers and businessmen (see Table 1). The three largest contributors, with 200 *riksdaler* each, were Mathias Flensburg, a merchant and the city's largest shipowner, board member of the Navigation school, and founder of *Malmö Sparbank*;⁴⁷ Lorentz Isak

41 Diebolt, Le Chapelain, and Menard (2021); Squicciarini and Voigtländer (2015); Mokyr (2005); Mokyr and Voth (2009).

42 Proposition no. 1 (1850/51), 50–54.

43 Statsutskottets utlåtande no. 87 (1850/51), 21.

44 Statsutskottets memorial no. 152 (1850/51), 16.

45 Statsutskottets utlåtande no. 62 (1840/41), 8.

46 Statsutskottets utlåtande no. 122 (1856/58), 69.

47 Mathias Flensburg, <https://sok.riksarkivet.se/sbl/artikel/14228>, Svenskt biografiskt lexikon (article by Bengt Hildebrand), retrieved 2021-10-21.

Bager, a merchant and local politician;⁴⁸ and Frans Henrik Kockum the elder, also a local politician but most importantly the founder of what would become one of Sweden's largest mechanical workshops.⁴⁹

Table 1. Fundraising drive for a technical school in Malmö 1850—contributors and contributions

Number of contributors	Contribution (riksdaler banco)	Sum (riksdaler banco)
3	200	600
9	100	900
2	66	132
9	33	297
6	25	150
18	20	360
7	16	112
3	13	39
27	10	270
38	< 10	290
Sum: 122		3,150

Source: G2: 1, in G2 Kassaböcker (Cash books), Tekniska elementarskolan i Malmö 1853–1966 (Malmö Technical Secondary School 1853–1966), Malmö stadsarkiv (Malmö City Archive).

A technical secondary school was established in Malmö in 1853. During the next parliament session of 1853/54, the parliament decided on three more schools—in Borås, Örebro and Norrköping—each receiving a grant of 5,000 *riksdaler*. As was the case in Malmö, co-financing from the cities was a prerequisite for obtaining government grants.⁵⁰

All four schools saw their grant increased to 12,000 *riksdaler riksmünt* at the parliamentary session of 1856/58. The schools were also granted a one-time sum of 4,500 *riksdaler* each to use for acquisition of equipment. The background to the increase in government grants was a motion in the Clergy (*präteståndet*), represented by member of parliament and dean in Örebro, Wilhelm Gumælius, and treated by the standing committee of supply.⁵¹ The motion problematised the initial decision of 1850, which saw the government grants to the schools set 1,600 *riksdaler* lower than the initial proposition of 6,600 *riksdaler*. Since the initial proposal was already strained, this put additional pressure on the cities to supply the remaining 1,600 *riksdaler*, in addition to the facilities also supplied by the same cities. It was considered unfair that a city which fulfilled the requirements should be forced to supply an additional contribution.

The insufficiency of the grants was said to be most noticeable in the effects on teacher supply, an important theme that would recur later on in the period of study

48 Lorentz Isac Bager, <https://sok.riksarkivet.se/sbl/artikel/18984>, Svenskt biografiskt lexikon (article by B. Boethius.), retrieved 2021-10-21.

49 Carl Frans Henrik Kockum, <https://sok.riksarkivet.se/sbl/artikel/11704>, Svenskt biografiskt lexikon (article by Rune Kjellander), retrieved 2021-10-21.

50 Lundh Nilsson and Grönberg (2019), 262, 270–72.

51 Statsutskottets utlåtande no. 122 (1856/58), 64–69.

as well. To create a favourable environment in which technically skilled teachers would have an incentive to stay for a longer period, and not move to more lucrative employment opportunities within the industry, the wages needed to be improved; for this to be possible, a more generous grant was deemed necessary.

Gumælius included a budget table for the first year in the Örebro school, which is reproduced here in Table 2. For the first year, the principal received 800 *riksdaler*, while other teachers received at most 666 *riksdaler*. This situation was compared to the teachers in the upper secondary schools, where the most junior teacher would receive approximately 1,300 *riksdaler*. This comparison between the technical secondary schools and other school forms is an important point that we will return to below. The discussion led to an increase in the budget of the schools to 12,000 *riksdaler* each.

Table 2. Budget for the first year of the technical school in Örebro (*riksdaler banco*—nominal values)

Specification	Wage
Principal's wage	800.00
Wages for the teacher in ...	
Mathematics	666.32
Chemistry	666.32
Physics	350.00
Mechanics	300.00
Linear drawing	200.00
Free-hand drawing	200.00
Shop floor work	333.16
Language	533.16
Botany and zoology	133.16
History and geography	133.16
Other expenses	
Janitor	200.00
Library	33.16
Laboratories	200.00
Lighting, firewood, cleaning, etc.	250.00
Total	5,000.00^a

Source. Statsutskottets utlåtande No:122, 1856–58, 66.

Note. The data given in the report seem to contain an error, as the sum total is actually 4,998.44 *kronor*.

The early years

According to the first regulations, the aim of the schools in Malmö, Borås and Örebro was twofold: to provide necessary elementary knowledge to those who wanted to engage in industrial occupations and to prepare for entry into higher technical education.⁵² The aim of the Norrköping school was strictly set to prepare for an occupation.⁵³ Entrance requirements were the same for all schools; the applicant should have reached the age of 14 and be able to present grades either from an educational institution or from a private teacher. In some cases, admission tests could be arranged. Admitted students paid a tuition fee; in Malmö, for example, this amounted to 12.50 *Riksdaler banco* per term in 1854⁵⁴—a sum equivalent to around 160 working hours for an average worker in the mechanical industry.⁵⁵

Right from the start, a three-year education was offered in all schools except Örebro, which due to financial problems during the first years only managed to offer two years of education.⁵⁶ In Norrköping, after the first year students were divided into two different programmes—the mechanical and the chemical programme⁵⁷—while the other schools, up until the late 1870s, offered the same education for all their students. The content of the teaching also differed, partly due to different local and regional industrial traditions, and partly due to the schools' different orientation in terms of preparing for higher studies. In the late 1850s, general subjects such as history, geography, and languages held a relatively prominent position in Malmö and Borås. Appendix 1 and appendix 2a–2c shows a timetable from Malmö technical secondary school in the spring term of 1857. Over time, these schools approached the stronger technical concentration of the schools in Norrköping and Örebro (Table 3).

Table 3. Amount and share of total teaching: technical/natural science and general subjects up to around 1872

Subjects	Malmö		Borås		Örebro		Norrköping	
	Hours	%	Hours	%	Hours	%	Hours	%
Technical/natural science	3,380	84	3,180	74	2,850	88	3,160	93
General	660	16	1,122	26	400	12	250	7
Total	4,040	100	4,302	100	3,250	100	3,410	100

Source: Malmö 1876:7 (1874), 24; Borås (do), 27; Örebro (do), 20; Norrköping (do), 12.

52 See, for example: SFS 1856:18, *Stadgar för tekniska elementarskolan i Örebro* (NA, 1856).

53 SOU 1876:7 (1874), 11.

54 G2:1 1850–1859, Kassaböcker (*Cashbooks*), Malmö Tekniska Elementarskola (*Malmö Technical Secondary School*), Malmö Stadsarkiv (*Malmö City Archives*).

55 Calculated after: Svante Prado, "Nominal and Real Wages of Manufacturing Workers, 1860–2007," in *Historical Monetary and Financial Statistics for Sweden, Volume I: Exchange rates, Prices and Wages, 1277–2008*, ed. Rodney Edvinsson, Tor Jacobson, and Daniel Waldenström (Stockholm: Ekerlid, 2010); Rodney Edvinsson and Johan Söderberg, "A Consumer Price Index for Sweden 1290–2008," *Review of Income and Wealth* 57, no. 2 (2011), 270–92.

56 Otto Gallander, "Bidrag till tekniska läroverkets i Örebro historia," in *Tekniska föreningen i Örebro 1875–1925: Minnesskrift utgiven med anledning av föreningens femtioåriga verksamhet*, ed. E. Forsberg and E. Adlers (Stockholm: Bröderna Lagerström, 1925), 34–35. (accessed January 5, 2021).

57 SOU 1876:7 (1874), 12.

The accounting books from the school in Malmö allow us to paint a partial picture of what the government grants were used for in this initial period. In 1858, wages accounted for just over 81 per cent of the grants, while the remainder were distributed to the library (eight per cent), machinery (four per cent), the workshop (two per cent), and other minor expenses.⁵⁸ Between 1870 and 1878 we can see that around 70–75 per cent of the grants were used for wages.⁵⁹

We have seen how, in the mid-19th century, Wallmark's proposal gave rise to the technical secondary schools aiming to provide a set of intermediate skills that were considered necessary for the progress of the nation. However, here we should remind ourselves that although the fluent narrative might suggest so, the development of a nation is not a simple task. There are many variables to balance when the budget is created, and there are many stakeholders with potentially conflicting goals.

We are reminded of this in the parliamentary session of 1850/51, where the standing committee of supply recommended that the proposition be rejected. Another example can be found in Stockholm, where neither the city council nor the parliament wanted to fund another school. Lastly, we can see this in the discussion of insufficient wages that arose early on in the period. The latter is an important point of discussion that will recur in the period between the two major reforms, the first of which will be discussed in the next section.

Economic development and educational reforms

From the 1850s, parts of the emerging Swedish industry developed at a rapid pace. Mechanisation and new types of energy, such as steam engines and hydroelectric power, contributed to the rapid growth of large industries. Until the end of the 1860s, the domestic market was the driving force. Cotton weaving mills, mechanical workshops, soap factories, and match factories were among the first branches to show high annual percentage growth. During the period from 1850 to 1870, the sawmill industry was the leading Swedish export industry, but at the end of the period new export sectors, like the pulp and paper industry and the dairy industry, became increasingly important. The following decades saw new industries stimulated by a growing domestic market. Carpentry shops, glassworks, porcelain factories, and sugar mills were among the most fast-growing industries, as were those producing more luxurious consumption goods like tobacco and beverages.⁶⁰

The ensuing transformation of the Swedish industry, starting in the 1890s, meant that new sectors, such as the engineering industry, became the motors of growth. The global economy favoured Sweden—abundant natural resources attracted foreign capital. The inflow of capital and outflow of labour, the latter due to extensive migration, caused wages to rise. As a consequence, domestic demand for consumer goods as well as for machines for the expanding industry increased rapidly. Taken together, these factors led to the Swedish economy becoming the fastest-growing in

58 G2:1 1850–1859, Kassaböcker (Cashbooks), Malmö Tekniska Elementarskola (Malmö Technical Secondary School), Malmö Stadsarkiv (Malmö City Archives).

59 G2:3 1870–1877, Kassaböcker (Cashbooks), Malmö Tekniska Elementarskola (Malmö Technical Secondary School), Malmö Stadsarkiv (Malmö City Archives).

60 Lennart Schön, *An Economic History of Modern Sweden* (London & New York: Routledge, 2012), 102–3.

the world between 1890 and 1930.⁶¹ However, the government and representatives of both industry and academia were, on several occasions, concerned that technical education in Sweden did not maintain the same level as in other, competing countries. Two major reforms—the first in the middle of the 1870s, the second in the early 1900s—will be briefly examined below.

The first major reform

In 1872, the Swedish Government appointed an inquiry into the existing technical education. The result was two official reports in 1872 and 1874. The former dealt with a reorganisation of the Technological Institute into a university of technology,⁶² while the latter concerned the lower technical education, including the technical secondary schools.⁶³ In the 1872 report, the committee stated that Sweden could not remain passive to scientific and technological advances due to the ongoing competition between the world's industrialised countries. The committee concluded, rather dramatically, that it was all about a struggle for existence.⁶⁴ Another group that had obtained insights about the importance and need for technical education based on theoretical studies was the industrialists, who had earlier relied, more or less, on traditional on-the-job training.⁶⁵

Like Wallmark in the 1850s, the 1874 committee recognised Germany as a country at the forefront in terms of systematisation of elementary technical education. However, the committee did not content itself with the impressions of the German schools. As examples, the well-known *Conservatoire des arts et métier* in Paris, the technical schools in Anger, Aix, and Chalon-sur Marne, which aimed to educate skilled foremen and workers for the mechanical industry, and *La Martinière* in Lyon with the same aim, were mentioned; however, the German *Gewerbeschulen*, which underwent a reorganisation in 1870, again ended up becoming the model for the Swedish technical secondary schools.⁶⁶

The committee highlighted some areas that had to be improved in order to catch up with technological development:

1. *The purpose of the education*—technical secondary schools should concentrate entirely on training leaders at lower levels, such as foremen, leaders in small industries, and leaders in construction. Preparing students for higher technical education should be the responsibility of the upper secondary school (*realskolans högre avdelning*) with its broad general education.⁶⁷
2. *The requirements for prior knowledge*—a large influx of technically interested students and increased knowledge requirements in the industry paved the way for stronger formal entrance requirements, with the junior secondary school (*realskolans lägre avdelning*) as an appropriate level.⁶⁸

61 *Ibid.*, 136–38.

62 SOU 1874:2 (1873).

63 SOU 1876:7 (1874).

64 SOU 1874:2 (1873), 3.

65 SOU 1876:7 (1874), 5.

66 *Ibid.*, 9–10.

67 *Ibid.*, 32–33

68 *Ibid.*

3. *Specialisation*—technological development called for more specialisation, especially in some larger industries, but many small industries could make better use of all-round technicians. Therefore, the committee proposed a compromise. The division into a mechanical and a chemical programme was recommended for the schools in Malmö, Borås, and Örebro. In Malmö and Norrköping, the two largest cities, a special construction programme would be set up. However, the division should take place as late as possible during the education (Appendix 2a–2c).⁶⁹
4. *A stronger emphasis on technical and scientific subjects*—with prior studies in the junior secondary school, the students had already acquired basic knowledge in general subjects.⁷⁰
5. The *teachers*—fewer teachers with a greater teaching obligation instead of many teachers with other obligations would enhance the quality of the teaching.⁷¹
6. *Costs*—the proposed reorganisation meant an increase in government costs, with teachers' salaries as the largest expense item, for the four schools by 34 percent (from 61,500 *kronor* to 82,400 *kronor*).⁷²

The committee also proposed a reorganisation of the teacher wage system. Now, wages should be per teacher and year, as opposed to a fixed wage per hour of instruction. The committee suggested that the schools maintain a small set of teachers in the main subjects (mathematics and physics, chemistry, mechanics, construction, and practical geometry), while instruction in other subjects could be assigned to non-permanent teachers. The main teachers should have a yearly salary of at least 3,000 *kronor* each, with a seniority allowance consisting of two stages, with one increase of 500 *kronor* after five years, and another increase of 500 *kronor* after another five years.⁷³ Finally, a position combining the roles of principal and teacher would receive a yearly salary of 4,000 *kronor*.⁷⁴

Although the schools' budget increased in 1856/58 as a result of the motion by Gumælius, we have reason to believe that the status of the teachers remained less favourable than teachers in other educational institutions, at least until the reform. First, one clue comes from the accounting books of the Malmö school. Figure 1 shows the wages paid to teachers between 1855 and 1873 and reveals a remarkable lack of change after the initial increase. Since the values are nominal, we can immediately see that there was no attempt to account for changing price levels in the wages, which seems like an odd notion for such an extended period of time.

69 Ibid., 37–39.

70 Ibid., 48.

71 Ibid. 57.

72 Ibid., 65.

73 Ibid., 62–65; Statsutskottets utlåtande no. 22 (1876), 25–7.

74 Statsutskottets utlåtande no. 22 (1876), 26.

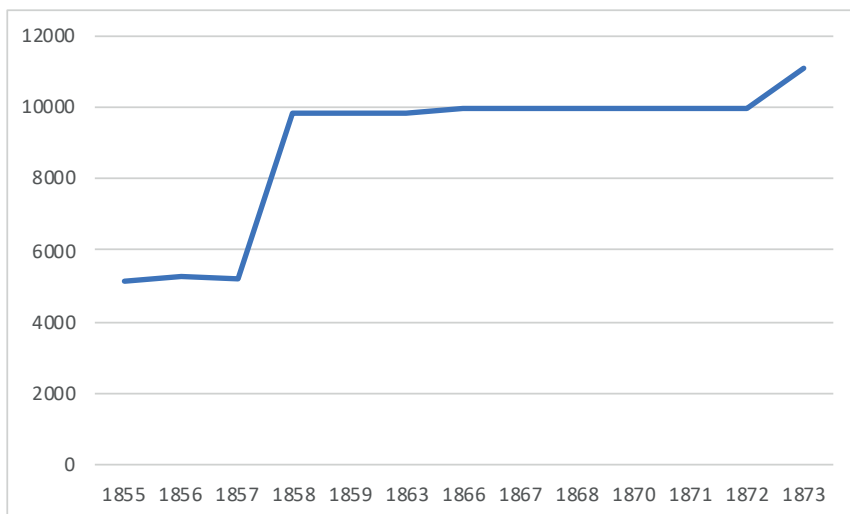


Figure 1. Total wages in the Malmö school before 1873 (*riksdaler banco*—nominal values). Source: G2: 1, 2 and 3 in G2 *Kassaböcker* (Cash books), Tekniska elementarskolan i Malmö 1853–1966 (Malmö Technical Secondary School 1853–1966), Malmö stadsarkiv (Malmö City Archive).

Second, the technical education committee that delivered its report in 1874 expressed the opinion that the economic premium of a teacher position at these schools was so low compared to the industry that talented individuals should be attracted by offering a more secure position than they had at the time; thus, these teachers should receive a pension according to the same rules as other teachers at the same educational level. Again, we see a comparison and a connection to the more theoretical school forms.⁷⁵

Unfortunately, when the reform was implemented in the late 1870s, a severe economic downturn led to decreasing interest in technical education and, in Malmö for example, the number of students dropped from 102 in 1877 to 51 in 1885. The school in Borås had the same problems recruiting students, with 92 students in 1876 but fewer than 40 students in the mid-1880s. Thereafter, the number of students rose again in both Malmö and Borås, but did not reach its previous level until the turn of the twentieth century.⁷⁶

As industrialisation progressed in Sweden, changing conditions in industry and society gave rise to friction between the purpose of the schools and what they were actually accomplishing. Thus, the spectrum of reform points was rather broad. The committee recognised that teachers' wages were important to the to-be-reformed system. As industry grew rapidly, the system also had to keep up with the changes, or else skilled teachers would not be attracted to the positions offered by the schools. This would become a more pronounced problem near the turn of the century, before the second reform.

⁷⁵ SOU 1876:7 (1874), 58–59.

⁷⁶ Fritz Montén, *Malmö teknologförbund: Minnesalbum utgivet i anledning av Malmö tekniska läroverks 75-åriga verksamhet: 1853–1928* (Malmö: Rektor Montén, Tekniska läroverket, 1928), 21; Borås: Database.

It is also useful to compare the technical secondary schools with the technical Sunday and evening schools that were discussed in the same report. The committee also suggested that certain means be made available to support these schools, and for the 15 schools that were counted to this category at the time, a total of 50,000 *kronor* was proposed.⁷⁷ This amounts to an average of just over 3,000 *kronor* per school.

The second major reform

Large-scale urbanisation and the expansion of the railway network during the late nineteenth century meant an increasing need for constructional engineers all over the country. Thus, the school in Borås established a construction programme like the one in Malmö and Norrköping in 1897, and Örebro followed in 1902. The most important event, however, was the establishment of a new technical secondary school in Härnösand in northern Sweden in 1901.⁷⁸

Fear that Sweden, despite its strong industrial development, was left behind regarding the share of students taking part in basic technical education and the government grants spent on it, as well as new innovations, such as the use of electricity and the internal combustion machine, led to the appointment of a new committee in 1907, which presented its proposal in 1912. Similar fears were also voiced by groups such as the engineering meetings and the Swedish handicraft organisation (*Sveriges hantverkarorganisation*).⁷⁹

Discussions of this kind can also be seen in the parliamentary minutes. The budget proposition from 1905 contains a detailed report of the wage-situation. In 1899, a third level was added to the seniority allowance, giving an additional 500 *kronor* after five years.⁸⁰ This change was due to a series of petitions by the school boards to improve the wages at the schools. However, whereas a seniority allowance with four levels was petitioned for, only one additional level was added. Further petitions from the teachers ensued, and again a comparison with the secondary grammar schools was made. Once again, concerns were voiced that if the wages are not sufficient, skilled individuals will gravitate toward employment in industry instead.⁸¹

The situation described by the school boards was not simply a hypothetical fear about what could happen if the situation was not improved. In 1895 the teacher in construction, Carl Jacob Magnell, left his position at the school in Borås to seek a more economically feasible position elsewhere. After two rounds of advertisement, the position was finally filled, but the position was open again after only five years. Once again, the position was advertised twice, but this time less successfully. The first round of advertisements received no applicants at all, and while the second round attracted two applicants, neither were qualified. The result was that, at the

77 SOU 1876:7 (1874), 148.

78 SOU 1918:10 (1912), 15. The establishment of a school in Norrland was preceded by a fight between the industrial city of Sundsvall and the city of learning, Härnösand. Unlike the establishments in the 1850s, the school town's educational traditions were considered an advantage. Lundh Nilsson and Grönberg (2019).

79 Nilsson (1981), 54–55.

80 Proposition 1, part 8 (1905), 103. The proposition also comments on the lack of change since the reform in 1877.

81 *Ibid.*, 105.

time of the proposition in 1905, the school still had trouble filling the position, and used substitutes to make the best of the situation.⁸²

The standing committee of supply had nothing to object against the proposition, especially given that the wages in the general education system had been reformed the year before.⁸³ Thus, the teachers in the secondary technical schools would receive increases in their wages of 500 *kronor* after five, 10, 15, and 20 years of service, along with new pension regulations and a system for sick leave. This led to a corresponding increase in the schools' budget, which accounts for the step we see after 1905 in Figure 3 below.

The new committee that was formed two years later criticised the hitherto small amount of specialisation, which despite the introduction of different programmes, was the result of the previous reform. Technological development now called for further specialisation. The committee pointed to five critical areas: (1) an overly long period of study, (2) division of programmes being done too late, (3) too many subjects, (4) too much focus on general, non-technical subjects, and (5) too many compulsory technical subjects instead of greater specialisation in the various programmes. As a solution, a new organisation was presented, according to which educating technicians with practical knowledge should be taken care of by specialised two-year technical schools (*fackskolor*). These should not only specialise in the three above-mentioned programmes, but also in electronics, road and canal building, timbering, textile industry, and the paper and pulp industry.⁸⁴ An important aim was to impart the technical knowledge, which together with industrial experience was required by those who were to supervise and manage work in workshops, factories, and other industrial workplaces such as engineering offices and laboratories. Technical schools should also provide knowledge to people who were engaged in business activities within the industry.⁸⁵

The committee's proposal in 1912 was received with some benevolence, but there was also criticism of the decision to shorten the education to two years and the early specialisation. Critics argued that the industry was still in need of comprehensively educated technicians and that education would be too one-sided. The modern industry needed technicians with linguistic and mercantile knowledge that neither the current technical secondary schools nor the new specialised technical schools could provide.⁸⁶ A new revised proposal was presented in 1918, probably delayed due to the First World War. The proposal was approved by the parliament, with some minor changes, and a new regulation was issued in 1919 that meant the end of the technical upper secondary school era. The reorganisation started in 1919 with the introduction

82 *Ibid.*, 107.

83 Statsutskottets utlåtande no. 9 (1905), 19–24.

84 SOU 1918:10 (1912), 53–55.

85 Proposition no. 335, *Kung. Maj:ts nådiga proposition till riksdagen angående omorganisation av den lägre tekniska undervisningen* (1918), 6.

86 Montén (1928), 24–25. For more about new knowledge required in the industry, see, for example, Boel Berner, *Sakernas tillstånd: Kön, klass, teknisk expertis* (Stockholm: Carlsson, 1996); Bosse Sundin, *Den kupade handen: Historien om människan och tekniken* (Stockholm: Carlsson, 1991); Alf Johansson, *Arbetarrörelsen och taylorismen: Olofström 1895–1925: En studie av verkstadsindustrin och arbetets organisering* (Lund: Studentlitteratur, 1990).

of the two-year specialised technical school and a three-year technical upper secondary school.⁸⁷

As we have seen, both reforms led to major overhauls of the schools. In terms of funding, this meant that the government grants to the schools saw large increases. From this perspective, 1905 is also an important year as the grants were raised in response to a proposition that was prompted by an ongoing discussion on teacher wages. The comments by the standing committee of supply—that there was nothing to object to, especially once the wages in the general education system had been reformed—could be taken as a hint that the technical education system was somewhat left behind.

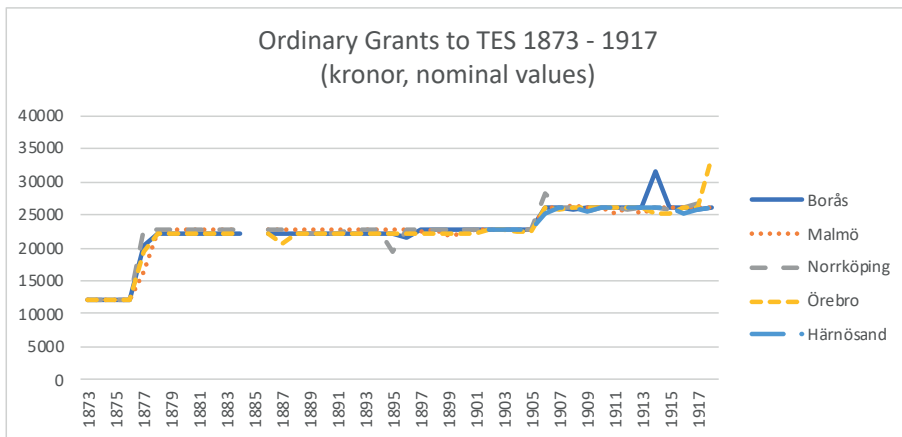


Figure 3. Ordinary grants to technical secondary schools 1873–1917 (in *kronor*—nominal values) Source. Riksdagens revisorers berättelse för år 1873–1918 (various years. Note. The year 1885 is missing from the reports).

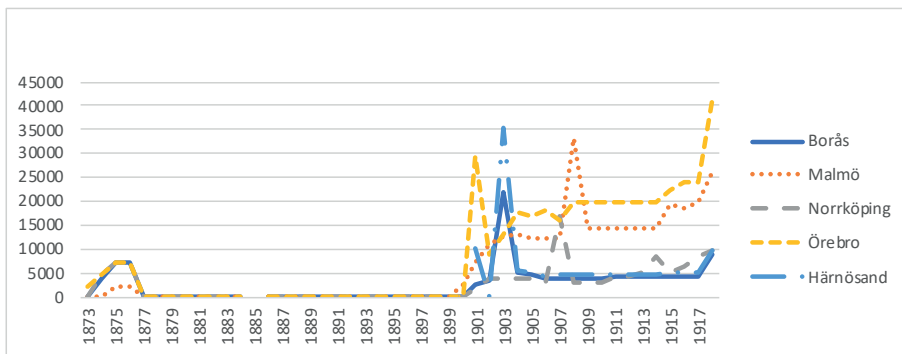


Figure 4. Extraordinary grants 1873–1918 (in *kronor*—nominal values) Source. Riksdagens revisorers berättelse för år 1873–1918 (various years. Note. The year 1885 is missing from the reports).

Figures 3 and 4 exhibit the changes in government grants between the two major reforms. The extraordinary grants in the mid-1870s are in preparation for the coming

87 Montén (1928), 23–24.

reform. The extraordinary grants that are frequently allocated from 1900 seem to have been of a somewhat different nature. As we have seen, at the turn of the century the school boards made several petitions to the government to increase the insufficient wages, which led to a decision of a new wage system in 1905. However, it was not only the wages that were insufficient, but the overall budget. The school in Norrköping reported in 1897 that the 900 *kronor* that were allocated to illumination and heating were insufficient, as these expenses had amounted to 1,800 *kronor* per annum during the period 1887–1896.⁸⁸ Also, the Borås school had problems. As the city lacked a gas-works, it had to rely on the more expensive electricity for illumination. Moreover, the expansion of the school's facilities, combined with a sharp increase in fuel prices in the city, led to the school having problems with the heating budget as well.⁸⁹

The reason these expenses were covered via extraordinary grants, and not a raise in the ordinary grants, was that such a change was deemed to require a more substantial investigation before any action could be taken.⁹⁰ Thus, we see frequent extraordinary grants in the last subperiod before the next major reform, the two most common purposes being “in support of school operations”⁹¹ and advance borrowing from the next year's grants.

This tendency to not decide on a major change without the support of a formal inquiry is prevalent in parliament, and we believe that it could, at least partially, be responsible for the stepwise nature of the grants over time. When something changes in the factors affecting the system, which the change is political, social, or economic, the actors will eventually perceive this as something that must change. However, to drive a change through parliament, an inquiry must first be instigated, which may take several years to complete. When the inquiry is complete, a proposition can be put forward to parliament.

Thus, the stepwise character in Figure 3 is thought to be due to a resistance to change. However, there are ways to increase the budget to the schools without requiring a major reform, which is the extraordinary grants—by granting the schools a temporary increase, budget requirements can be met without the need to reform the system.

Donations and bequests

We have investigated how the government grants changed over time. However, although the main source of income was the government grants, the schools also received funding from various other actors—both individuals and organisations—throughout the period of study. We have been able to gain some insight into this through the reports in parliament, a book about donations and bequests to the school in Norrköping 1815–1897,⁹² the accounting books from the school in Malmö, and a commemorative book on the school in Örebro.⁹³

88 Proposition no. 1, part 8 (1900), 306.

89 *Ibid.*, 311.

90 Statsutskottets utlåtande no. 9 (1900), 315.

91 *För upprätthållande av verksamheten*, authors' translation.

92 Unspecified author, *Donationer till tekniska elementarskolan samt Ebersteinska söndags- och afton-skolan i Norrköping—åren 1815–1897* (Norrköping: Norrköpings tidningars aktiebolag, 1900).

93 Martin Lien, *Högre tekniska läroverket i Örebro 1857–1957: En minnesskrift på styrelsens uppdrag* (Örebro: Tekniska föreningen i Örebro, 1957).

Donations and bequests (henceforth referred to collectively as “gifts”) can be directed towards the school, but can also be directed toward the students at the school, which seems to have been the case for many of these in Norrköping. Although the lack of documentation is a limitation here, it seems the reports in parliament only list gifts in the form of direct transfers of money. Gifts of, for instance, mineral collections to promote instruction in science are not listed, nor is interest received from funds gifted to the schools. Since all forms of gifts benefit the school in some way, even if they are targeted at the students, we have decided to also include gifts that are not targeted directly at the schools.

At several points in time, the school in Norrköping received donations and bequests from various actors. However, direct monetary transfers to the school itself were rare. In March 1858, Baron Fr. Funck donated a collection of minerals to the school, in order to promote the scientific instruction, and in November 1860, medical doctor Sir L. P. Hanssén donated his collection of “shells, molluscs, and other natural phenomena together with the cupboard that houses them.”⁹⁴

Between 1870 and 1900, the various donations and bequests were not for the school per se; rather they consisted of funds to be allotted to students who distinguished themselves in diligence or behaviour. Thus, in April 1884, a civil engineer and former student at the school named J.A. Andersson bequeathed in his will a fund of 5,000 *kronor*, the interest of which was to be allotted to one student who distinguished himself. Organisations also donated in this way. In August of 1870 the labour association of Norrköping (*Norrköpings arbetareförening*) started a fund to reward distinguished students at the school and the connected technical Sunday school. For the Örebro school, Martin Lien lists a total of 24 gifts between 1865 and 1920.⁹⁵ Most of these were similarly aimed at students who distinguished themselves, but three of the gifts have “no clauses in particular” attached, which may indicate that they went to the school directly, although the details are unknown.

If these facts generalise to all five schools and the entire period of study, it seems gifts did not have a direct impact on the schools. However, gifts directed to the students can be expected to affect the school indirectly by raising the popularity of the school, by encouraging the students to work harder, and possibly by allowing poorer students to finish the education in cases where they would not otherwise have been able to. This highlights the need for future research to focus on the students and the effects of these gifts.

Conclusions

In this article, we have documented changes in the structure and financing of the technical secondary schools, from their establishment in the 1850s to the end of their era, marked by the new regulations in 1919. The focus of our study has been on different types of financiers, the financial consequences of the two major reforms in the mid-1870s and early 1900s, the technical secondary schools’ government grants in relation to other forms of schooling, and the specific question of the impact of wages on opportunities to recruit qualified teachers.

⁹⁴ Unspecified author (1900), 47.

⁹⁵ Martin Lien (1957), 173–76.

Early proponents of the schools included not only educationalists but also members of parliament, local politicians, local industry, and individual stakeholders. It was made clear from the beginning that the cities that applied for a technical secondary school must be ready to co-finance the school. During the establishment phase, private financiers seem to have played a significant role through fundraising and grants. In Malmö, for example, the city's application for a state subsidy for a technical school was preceded by an extensive collection of funds from manufacturers, businessmen, and other citizens.

When Wallmark's proposal to establish two technical secondary schools was discussed in the parliament, the cost per school was calculated at 6,600 *riksdaler*. However, the standing committee of supply initially wanted to reject the sum altogether, but three out of four estates managed to convince the committee to agree to a yearly grant of 5,000 *riksdaler*, which left the necessary 1,600 *riksdaler* to be paid for by the cities themselves. However, it was considered unfair that cities that had already fulfilled their requirements should be forced to pay an additional contribution and this caused serious protests. After lengthy discussions, the parliament decided to increase the budget to 12,000 *riksdaler* for each school. After the establishing phase, government grants rose by stages but remained the same in nominal values for extended periods. At regular intervals, the school boards felt compelled to complain to the government and request increased funding. Private donations to the schools that were important in the beginning later took the shape of donations and bequests intended for students' grants and/or different kinds of teaching facilities.

The extent and quality of Sweden's different levels of technical education remained a burning question during the second half of the 19th century. The fear that Sweden would not be able to keep up with the competition in the international markets seems to have been a driving force in the further development of the technical secondary schools. In the official reports, comparisons with other countries regarding the share of students taking part in basic technical education, and the governments grants spent on it played an important role. It became clear that the state must take greater responsibility for the technical schools in the same way as other industrial competitors did. As a common thread throughout the existence of the technical secondary school, there was the comparison with the conditions in Germany, which was seen as the pioneering country when it came to technical education at all levels. The reform in the 1870s, which among other things, proposed specialisation, and a stronger emphasis on technical and scientific subjects, led to major government investments. Not least important was the tardy establishment of a technical secondary school in Härnösand in 1901, the main task of which was to educate young men from the northernmost parts of the country.

During the initial discussion in the parliament about the location of the technical secondary schools, one of the core issues was the opportunity to obtain qualified teachers. In the end, the parliament chose to establish the first four schools where there was already a somewhat developed industry instead of in cities of learning. Despite an initial fear of a possible shortage of suitable teachers in the industrial cities, other aspects gradually came to dominate the teacher question. The main focus was the fact that the employment conditions and salaries at the technical secondary schools could not compete with the salaries at the corresponding stage in other school forms. However, the industry gradually also became a threat to the recruit-

ment of teachers as it could offer higher salaries and better employment conditions. Thus, the wage issue came to characterise a large part of the reform work. Since salaries were the largest item of expenditure from the outset, improvements in the area led to significantly increased costs.

The discussion about teachers' salaries was, in a sense, also about the status of the technical elementary schools in the education system. The educational level of the technical secondary schools matched what Diebolt et al. call *intermediate human capital* and they arguably occupied a level between elementary technical education in the Sunday and evening schools and scientific knowledge, as disseminated by the Technological Institute. The investigations that preceded the two reforms strongly emphasised the importance of training technical leaders at lower levels, such as foremen, and leaders in small industries. If scientific progress is driven by what Squicciarini and Voigländer call the *knowledgeled elites*, who are in possession of what Mokyr has coined *upper-tail knowledge*, it is the foremen and the shop-floor level engineers and technicians who shoulder the burden of managing and operating the machines that are the result of new scientific principles. Therefore, the reforms on secondary technical education during the 19th and early 20th centuries, not least in terms of increased funding and improvements in teachers' salaries and employment conditions, should be seen as an acknowledgement of their importance by the state and the other stakeholders.

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G1:1 Tekniska elementarskolans arbetsordningar 1854–1883, Tekniska elementarskolan i Malmö 1853–1966, Malmö stadsarkiv.

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Appendix

Appendix 1. Timetable Malmö technical secondary school spring term 1857

		Upper form	Lower form
Monday	8–12 a.m. 2–3 p.m. 3–4 p.m. 4–5 p.m. 5–6 p.m.	Chemistry—laboratory work German language Physics Physics	Linear drawing German language Arithmetic and algebra Arithmetic and algebra
Tuesday	8–10 a.m. 10–12 a.m. 2–3 p.m. 3–4 p.m. 4–5 p.m. 5–6 p.m.	Free-hand drawing History and geography French language Arithmetic and algebra Arithmetic and algebra	Geometry Chemistry French language Botanic and zoology Botanic and zoology
Wednesday	8–10 a.m. 10–12 a.m. 2–3 p.m. 3–4 p.m.	Mechanics Swedish language English language	Free-hand drawing Swedish language English language
Thursday	8–10 a.m. 10–12 a.m. 2–3 p.m. 3–4 p.m. 4–5 p.m. 5–6 p.m.	Mechanics Physics German language Chemistry Chemistry	Linear drawing Linear drawing German language Arithmetic and algebra Arithmetic and algebra
Friday	8–10 a.m. 10–12 a.m. 2–3 p.m. 3–4 p.m. 4–5 p.m. 5–6 p.m.	Linear drawing Linear drawing French language Algebra Algebra	Geometry Chemistry French language Arithmetic Arithmetic
Saturday	8–10 a.m. 10–12 a.m. 2–3 p.m. 3–4 p.m. 4–5 p.m.	Shopfloor work Shopfloor work English language Shopfloor work	History and geography Free-hand drawing English language

Source: F2B:1 in G1:1, Tekniska elementarskolans arbetsordningar 1854–1883 (Technical Secondary School—programmes). Malmö tekniska elementarskola (Malmö Technical Secondary School), Malmö Stadasarkiv (Malm City archive).

Appendix 2a. Proposed distribution of subjects—First year (all students)

Subject	Autumn term	Spring term
Pure mathematics	11	11
Chemistry	3	3
Geometry and linear drawing	8	8
Swedish language	2	2
Free-hand drawing	4	4
Shopfloor work	6	6
Total	34	34

Source: SOU 1876:7 (1874), 45.

Appendix 2b. Proposed distribution of subjects—Second year (mechanical and construction program/chemistry program)

Subject	Autumn term	Spring term
Pure mathematics	8/8	2/2
Mechanics	4/4	7/7
Physics	5/5	6/6
Chemistry	3/3	0/0
Laboratory lessons	0/0	0/8
Geometry and linear drawing	4/4	4/4
Machine drawing	0/0	4/0
Bookkeeping and commerce	4/4	2/2
Swedish language	2/2	0/0
Mineralogy and geodetics	0/0	3/3
Shopfloor work	4/4	4/0
Total	34/34	32/32

Source: SOU 1876:7 (1874), 45-46.

Appendix 2c. Proposed distribution of subjects—Third year (mechanical/construction/chemistry program)

Subject	Autumn term	Spring term
Pure mathematics	2/2/2	2/2/2
Applied mechanics	3/3/3	3/3/3
Machine drawing	11/6/4	12/6/4
Engineering	3/3/3	3/3/3
Geodetics	0/0/0	2/2/2
Shopfloor work	8/0/0	8/0/0
Construction	5/16/5	0/14/0
Chemistry and laboratory work	0/0/15	0/0/16
Total	32/30/32	30/30/30

Source: SOU 1876:7 (1874), 46-47.