

Vocational Education for Crafts and Industry in Norway

Bjørn Magne Aakre

Abstract

The purpose of this article is to explore vocational education in Norway and its relation to the evolution of crafts and industry. The approach is inspired by Grounded Theory (GT) which is a systematic but flexible research method. By describing and analyzing phenomena, one develops possible theories and explanations through coding, constant comparison and densification of categories.

As sources, a combination of qualitative and quantitative data from public documents and statistics, curricula and reports from an appropriate selection of schools were used, most of them from Kongsberg. The data were coded, analyzed and structured into three school categories, four time periods and finally five categories on content and learning methods. The categorization is arranged and adapted to the levels in the European Qualification Framework (EQF).

The study concludes that vocational education has changed over time and has been influenced by social conditions, ideology, business and industrial development. Today, vocational education is integrated into the national education system and is given high priority in vocational renewal 2020. The same applies to the vocational schools' role in future vocational education.

Today, most vocational education is organized as a "2 + 2 model" with 2 years of theoretical and practical education in schools followed by 2 years of apprenticeship in a private company or public institution. But a separate category of vocational education "type 2" still consists of, among other things, design, arts and crafts and which is not based on the apprenticeship scheme.

The latest government report on future vocational education proposes that the right to free education should also apply to everyone over 25 years of age. This contributes to a relatively high drop-out rate in the Norwegian vocational education.

In a few years, the oil economy in Norway will end and many new "green" jobs must be created. Against this background, it is a paradox that this challenge is not addressed in the latest report on future upper secondary and vocational education in Norway. However, sustainable development is emphasized in all subjects of the new curriculum LK20.

Key words: vocational education, technical education, secondary education, Norway

1. Introduction

The curriculum reform LK20 (Udir, 2020) of upper secondary education in Norway is the latest in a long line of reforms of academic, vocational and technical programs. There are also vocational and technical colleges. The purpose of this article is to explore their history, trends and contemporary discourse. What is old and what is new in the reform?

Today, vocational and technical education is a major area of education in most countries, often linked to vocational college and higher education. They have their own history and traditions, and based on ideas different from general education. Such programs in Norway are both similar and different from such programs in other countries (Aakre, 2017 and 2019). Technical education is post-secondary vocational education, equivalent to technical colleges in USA (Duram and Bragg, 2019, p. 231). In Japan such colleges may be called Senmom, Junior Colleges or part of five-year Technical College. In Germany Berufsschule and Berufsfachschule.

Vocational educational has, in a historical perspective, been justified on the basis of various purposes and educational ideas. Some has argued that work is a fundamental human activity and that all should be prepared for the life of work. The English philosopher John Lock introduced the concept “working school” as a means of preparing poor children for work (Lock, 1657). A similar concept “Arbeidsskole” appeared in Norway and introduced in the school law of 1860 as an extension to basic education for common people (Lov 1860, §7 and §8). The following hundred years there were many such local schools of various length and content. Gradually these schools were influenced by the progressive movement which emphasized activity and experience as basic values in education.

Some educators argued that handicrafts and doing things with hands and body is educative, not only as a preparation for work, but for the development of the human mind and human social life. Johann Amos Comenius saw it as a form of expressive arts and included arts as a compulsory subject in *Didactica Magne* (Comenius, 1657). Hundred years later Rousseau chose Emile to learn carpentry, he thought it is a common and decent work (Rousseau, 1762). Before 1866, crafts in Norway were trained party with the guilds in the cities, or as informal training in rural areas.

The social and democratic aspect of vocational education was even more emphasized by modern educators and the progressive movement. Georg Kerschensteiner introduced the concepts industrial school and “Arbeitshule” (Kerschensteiner, 2013). The concept is somewhat similar to the former concept “working school” in English and “Arbeidsskole” in Norway, but in a more modern context (Myhre, 1991, p.134). He developed the “Arbeitshule” into a systematic and wide spread system in Germany (Röhrs, 2000, p.5). He argued that vocational education were to make useful and purposeful citizens: first, by guiding the student to his proper life work; second, by planting the idea that each

vocation had its place in serving society; and third, by teaching the student that through a vocation society grew to a more perfect community. Kerschensteiner appealed to the students' practical interests by building the learning process upon their active participation in work projects and extracurricular activities chosen in accordance with their own interests. Participation and project work were to convert the school from a place of individual and intellectual singularity into a place of practical and socially serviceable plurality.

John Dewey expressed similar ideas, but he was more in favour of comprehensive education. Dewey proposed two overall goals: to assist individuals to identify the kind of occupation they find interesting and suited for, and to develop the capacities to enact that occupation (Dewey, 1916, p.308). As a more general approach he also differentiated between traditional vs. progressive education to explain his own philosophy on education (Dewey, 1938, p.17). The term progressive, he explained with categories like experience, social control, freedom, democracy, purpose, the organization of subject matter (content) and the means and goals of education

Since Dewey and Kerschensteiner, the global labour market in general has been experiencing considerable changes, affecting the supply of jobs in various occupations (Cohen, 2018). Therefore, a third purpose of vocational and technical education need to be added: to help people sustain their occupation across working life through life-long learning.

From the recent years, there is also a substantial international literature covering the diverse field of vocational education (Guile and Unwin, 2019). In some countries, post-secondary vocational education and its link and transfer to higher education is part of the contemporary discourse on education as well (NHO, 2018). However, there still seems to be no firm consensus on what vocational education is or what it should be in the future. The history, policy, length, content and learning strategy of vocational education varies around the world and a variety of concepts are used: Apprenticeship Training, Vocational Education, Technical Education, Technical-Vocational Education (TVE), Occupational Education (OE), Vocational Education and Training (VET), Professional and Vocational Education (PVE), Career and Technical Education (CTE), Workforce Education (WE), Workplace Education (WE), etc. Several of these terms are commonly used in specific geographic areas (Unevoc, 2017). The many concepts used and the lack of consensus indicates that vocational educational and practices are driven and guided by different ideologies, purposes, contents and learning methods. When doing research on education such differences are relevant for analyses. However, what categories are feasible to use for such analyses? To overcome this variation, the Norwegian Qualification Framework (NQS) Level 3-5, transparent to the European Qualification Framework (EQF), is used in this study ():

Table 3.2. Criteria from Norwegian Qualification Framework (NQF). Transparent with EQF

Level	NQF- Criteria. Transparent with EQF
2	<i>Certificate for primary and lower secondary education</i>
3	<i>Document of competence in basic competence, partially completed upper secondary education</i>
4	<i>Certificate for upper secondary education and training, Craft certificate, Journeyman's certificate</i>
5	<i>Diploma for tertiary vocational education (Enrolled in tertiary vocational education 1 and 2)</i>
6	<i>University College Graduate (Partial level qualifications/ intermediate qualifications), Bachelor's degree, General teacher training program</i>

It is not only the labour market that has changed, but also the philosophy of management of industry, business and education. In 2000, the first PISA tests were performed. Since then repeated every three years. Its aim is to provide comparable data with a view to enabling countries to improve their education policies and outcomes. This is a type of rational cybernetics theory where measurement data are used as feedback to control the performance of processes like leadership, financing, administration, teaching and learning outcomes. Linked to the market system this is often referred to as New Public Management (NPM) (Pollitt and Buckaert, 2004, p.188). Ralph Taylor had similar idea on his curriculum theory, but he did not bring in factors outside the processes of teaching, learning and evaluation. Justin Sim (2017) refers to models that incorporate such postmodern ideologies of educational success. He suggest a model with four analytical categories: 1) Cultural restoration, 2) New progressives, 3) Liberal Humanism, and 4) Techno-Rationalism. Educational success is tied to these factors as far as they shape curriculum content. However, they do not deal strictly with educational success in academic terms, but rather with its intended purpose in society. From these points of view, the research problem was formulated:

What is characteristic about vocational and technical education in Norway from a historical and contemporary perspective up to the 2020-reform, and how do programs in Kongsberg and Tinius Olsens School reflect these characteristics?

- a. *How has changes in politics, economy, technology and social and professional life influenced on the development of vocational and technical education in Norway?*
- b. *How has the structure, content and strategies of teaching and learning changed in vocational and technical education in Norway?*

2. Method

Grounded Theory (GT) was used as a frame of methodology for this study. It is a systematic but flexible research method where, in addition to describing phenomena, one also tries to build theory and possible explanation through constant comparison and structuring of concepts and statements (Glaser and Strauss, 1967; Strauss and Corbin, 1990, p. 23; Charmaz, 2015, p.16). The flexibility depends, among other things, on the types of data used. A combination of qualitative and quantitative data was emphasized (Corbin and Strauss, 2015, p. 42; Charmaz 2015, p. 330).

At first, a systematic selection of written sources from national archives, policy documents, laws and curriculums was done. Secondly, statistical data was extracted from national and local statistics. These data were coded, analysed, compared and compressed into feasible categories. Finally, hermeneutic content analyses were used to develop contextual understanding related to time and space as well as its historical context (Kvale & Brinkmann 2009, p.190).

Vocational education is often seen as the solution to both social and economic problems (Guile and Unwin, 2019, p.12). From this point of view, some discusses how the social processes associated with gender, ethnicity, and social class are manifested in vocational education, and how they are mediated by the structural, cultural, institutional, and labour market formations in which they are embedded. In this context, the study is also inspired by critical theory trying to reveal and challenge power structures and their transformation through interpreting and the envisioning of new possibilities for a peace (Creswell, 2013, p.30).

3. Roots: The autocratic agrarian society (1153-1850)

Long before formal schools in Norway, there were crafts of many kinds. They were improved and transferred from generations to generations. The first complete national law of Norway, compiled by King Magnus the Lawmaker in 1276 mention several such crafts. Some are about building ships and making sails and the many crafts involved (*Figure 3.2*), about navigation, as well as the crafts of keeping and making food on board (Lov, 1276). He also introduced special laws to regulate trades and crafts (Taranger, 1915, p. 44-5 4).

The roots of formal education in Norway starts in 1153, when the Catholic Church established five Cathedral Schools. However, for a long time Norway was an autocratic agrarian society. Households were still the centre of raising children, social life and production of daily needs. The households made tools and clothes, they build houses and boats, and they made equipment for farming and fishing.

Some traded took place on local markets and the first exports were dried fish, fur, some metals, whetstones and a few other products.



Figure 3.1. The Oseberg ship. Original built ca. 820 AC. (Photo: Saga Oseberg)

Gradually the Guilds, supported by the King, took control over production and trade in the cities. From about 1600, the Kings also opened industrial mining and ironwork. Export of lumber, some metals and shipping became major businesses. The King also introduced compulsory education for all as early as 1739.

Previous research has identified three educational traditions in Norway. They represent quite different ideologies, purpose, content and socioeconomic status (Aakre, 2005, p.405). Two of the traditions are in the domain of vocational and technical education:

Type 1: Education in crafts and industry leading to a crafts- or journeyman certificate. Here also referred to as the “Kerschensteiner Model”.

Type 2: Education in arts, crafts, and design leading to a general diploma. Here also referred to as the “Dewey Model”.

Type 3: Education in academic subjects leading to a general diploma. Here also referred to as the “Humboldt Model”.

In 1805, short before the Norwegian Constitution was passed in 1814, the typical export from Norway is listed in table 1. Due to liberalization of international trade, shipping was soon the fastest growing industry providing over 40% of revenue to Norway a few decades later. By 1875, Norway became the world's third largest nation in shipping. The maritime industry is still a major business.

Table 3.1. Main Exports and Employments in Norway 1805

Product	Value (Million Riksdaler)	Export in %
<i>Lumber</i>	4,5	37,5
<i>Fish</i>	2,7	22,5
<i>Shipping</i>	2,0	16,6
<i>Iron and copper</i>	0,8	6,6
<i>Other</i>	2,0	16,6

3.1 Type 3 Education for an academic career (1153-1875)

Education for an academic career in Norway was first established with five Cathedral Schools in 1153. They still exist, but will be described only briefly in this article. There are a few examples of crafts in these schools but their purpose was to educate priests and leaders in the church and to strengthen the church's religious, political and economic power. For a long time they were the only formal education available in Norway, and King Haakon Haakonson (1204-1263) was the first king of Norway who attended this type of school. In addition to theology, the seven free arts were taught: grammar, rhetoric, dialectics, arithmetic, geometry, astronomy and music. It is said that King Haakon was a good singer.

After the Reformation in 1536, these schools were transferred to the autocratic state as Latin schools, but with more or less the same purpose: to maintain the power of the King, the ruling classes and their privileges. Later they became more secular schools and finally replaced by Gymnasium in 1906, by me referred to as the “Humboldt Model” (Humboldt, 1809). In 1974 they were merged under a common law of upper secondary education, replaced by the present law of 1998 (Lov, 1998). The majority of students, but not all, going to technical university follow this track.

3.2 Type 1 Education for crafts and industry (1400-1875)

The roots of *Type 1*, as well as *Type 2* education, is informal training in the households. However, around 1360 the Hanseatic League established their first office in Norway. In addition to trade, they

introduced the guild system with apprentice training, which became one of its characteristics. With the technical schools around 1875, modern science based knowledge like mathematics, physics, mechanics and similar subjects were included. The apprentice system is still maintained in the 2020-reform, and therefore also referred to as the “Kescheneiner Model” in this study.

In exchange for financial support to King Haakon VI, the guilds received exclusive rights to start and operate trade and business in the cities in Norway (Aakre, 2005, p. 89). Gradually, the guilds and the apprentice system dominated crafts education in the cities. The first formal regulations were issued in 1621 and 1662. However, until 1866 the guilds were more or less autonomous in how they operated the apprentice system and the criteria to be a master with the right to start and run own business. Its purpose was threefold: to train highly skilled craftsmen, to control the entrance to the trade and to stay in business.

The apprentice system was also adopted by the early industries in Norway, such as mining and ironworks. At Kongsberg Silver mine an apprentice system was established around 1720 (Helleberg, 2000, p.126). These industries, gradually started to use mechanical technology, and education for this purpose was developed. This was also the beginning of higher technical education in Norway. Kongsberg College of Mining was established in 1757 and a Vocational College of mining in 1866 (Bergskolen, 1966, p.8). This school practice 3 days a week, and 3 days of theory with mathematics, geometry, trigonometry, chemistry, geology, physics, mechanics, book-keeping, law and study trips.

Maritime education

Norway has for a long time been a sailing nation and in 1637 a school for navigation was established in Bergen. The system of training was basically the same as in the guilds, but before 1850's less formal. To advance in the system the sailor had to earn experience on a ship and the best skilled. During the 18th century Norway became the world third largest nation on shipping. New exam requirements of 1839 led to the establishment of public (state) navigation schools in the following year. The first school established was Kristiania Seaman's School in 1845. Soon exam requirements for motor-men were also introduced and machine schools established combined with apprentice training on ships. (Eikeland, 2000).

From drawing schools to technical schools

During the Age of Enlightenment, more people became interested in Arts and Baumgarten published his work on Aesthetics (Baumgarten 1750). Drawing became both a useful skill and a way of artistic

expression. Drawing had already been a compulsory skill for Masters and Apprentices in the 17th century, and Craftsmen were able to draw and make things after drawing. A Guild Articles from 1680 mention drawing among the skills carpenters, carpenters, masons, and painters should be able to master (Sollied, 1915, p. 480). In 1772, the drawing school in Bergen was established, and in Kongsberg at the School of Mining, apprentices had to learn drawing. From 1802, Drawing-schools were started on Sundays for apprentices and masters in many cities. They were held on Sundays to avoid conflicts with the daily work. These schools became very popular and received government grants from 1848. From now on drawing became a compulsory subject in all vocational and technical education. Gradually science and technological subjects were included in these schools, and from 1875 most of them were changed to Technical Evening School. These schools founded the bases for entrance to the first technical schools in Norway. The first one, Horten Technical College, was established in 1855 as a state college to support industrialization and modernization of Norway. The school was located at the Naval Ship Yard in Horten that launched their first naval steam ship “DS NORDCAP” in 1840. One of its first students was Tinius Olsen from Kongsberg.

Tinius Olsen started his career as an apprentice at his father’s woodshop in Kongsberg. On Sundays, he attending the type of drawing-school already mentioned. The local industry made weapon for army and hunting (fig3.2)



Figure 3.2. Rifle M/1860/67 (KV). Kongsberg. (Photo: S. Rudnå)

In 1865, he became a student and graduated as the best student in 1866. Due to lack of work opportunities, he applied for a state scholarship to study abroad and ended up in Philadelphia USA. There he founded a distinguished company specialized in material testing, Tinius Olsen Testing Machine Co. Inc. On the 50th anniversary in 1905, he donated a fund to his former school. Later, in 1921 and 1924 he donated funds to Kongsberg Technical Evening School and a fund for a new technical school to be raised in Kongsberg. Tinius Olsen School was completed in 1960, with a comprehensive program from apprentice school on evenings, full time vocational school, technical school and college of engineering. The school was innovative and soon became one of the most popular schools in Norway. In 2016, the former Horten Technical College and Tinius Olsen Technical

College were merged into a university as Faculty of Technology, Natural Sciences and Maritime Sciences at University of South-Eastern Norway (USN, 2020).

3.3 Type 2 Education for arts, crafts and design (1153-1850)

Like *Type 1*, the roots of *Type 2* education is from informal training in the households. However, they were never ruled by the guilds and until the 2020-reform never related to the apprentice system. Their purpose have been to prepare for work, not train for work, and more similar to the idea of John Dewey. Therefore referred to as the “Dewey Model” in this study.

Some few private schools for girls had existed since had existed since the 1770, and common schools in the cities were allowed to introduce handicrafts for girls from 1848. The concept “working school” (arbeidsskole) was frequently used, and this concepts was adopted girls and boys by the Norwegian school-law of 1860 (Lov 1860, §7 and §8). The first school of this kind was Holmøy arbeidsskole established in 1868 with a one year course in wood- and metalwork. The following hundred years there were many such local ”working schools” (arbeidsskole) of various length and content. Gradually, these schools became influenced by the Progressive Movement, emphasizing activity and experience as basic values in education, and preparation for work as their purpose.

The first formal schools of this kind were also a reaction against the industrial system and industrial products of low quality imported from abroad. The purpose was partly to preserve good old Craftsmanship, local industry and more emphasize on aesthetic qualities. *Figure 3.3* shows national crafts of textile, silverwork, woodwork and music that had a renaissance from about 1850.



*Figure 3.3. National costumes and the Norwegian violin with 8 strings.
(Photo: Husfliden Skien and Halingdal Museum)*

This idea was followed up by several measures to utilize local resources and local crafts for the benefit of the local community. This trend was also inspired by the Romantic movement in Europe, like the Arts and Crafts Movement in England, followed by the national-romantic movement in Norway. Eilert Sundt, the founder of sociology in Norway, was an avid pioneer for such an education in Norway and the preservation of local handicraft, *home sløyd* (Sundt, 1867). The slogan of this education was “help for self-help”, motivating people to use local materials and resources, to be inspired by old arts and crafts and to start local businesses. In the first schools for women from about 1875, tailoring and weaving were the two main subjects. For a long time the emphasis was on rediscovering old folk costumes, weaving ribbons and fabrics and sewing them as part of education.

Due to liberalization in 19th century, the guild system and their exclusive rights were finally wound up, and the first Norwegian Craft Act introduced in 1839. The Trade Act of 1842 also gave single women the opportunity to establish business, do trade and provide for themselves (Bull, 1847; Mordt, 1993). Based on this trend the first schools of this kind, Holmøy Arbeidsskole was established at Nordfjoreid in 1858 (Aakre, 2005). Today is it Eid Upper Secondary School. The school had 1-year courses on day-school for men in wood- and metalwork. Christiania Women Industrial School (Kvindelige Industriskole) in Oslo in 1875 became the first school for women (Håberg, 2012). Today it is the Faculty of aesthetics and Oslo Metropolitan University. The concept “Industrial” was controversial and often discussed by the founders of the schools as they were more into arts and aesthetics than industry. But some schools continued to use the concept “industry” to indicate a possible career for single women, and because the funding system preferred schools for industry.

Other form of education before 1875

In the years before 1875 other schools were also started which are only briefly mentioned here. Already in 1539 the priests were given responsibility for teaching the auxiliary wives, adopted by law in 1687. In 1815 the first school for this purpose was started. Since 1986 education of midwives as well as nurses are in universities.

The Agricultural schools were started from 1825 to improve production of food. The motivation was to make Norway self-sufficient on food to avoid the problem of import during the Napoleonic wars causing starvation. This type of schools were merged with Type 1 schools in 1994, based on an apprentice system. The first schools of fisheries were not established until the end of 1930's, but today Type 1 schools.

The first school for home economics were started in 1865. Their main purpose was to prepare young woman for family life, but some also went to work in hotels or as domestic helper. After 1945, they were expanded to include health care and child care in a broad sense, and expanded a lot. Gradually they were merged with Type 1 schools some years after 1994, based on the apprentice system.

Finally, the first school of arts and crafts was started in 1818. First as a drawing school and for many years based on a sort of apprentice system. Gradually it was developed into an academic institution, and to today Oslo National Academy of the Arts with a variety of specialties in the arts.

4. Liberalization and industrialization (1875-1940)

In 1875, Norway was at the threshold of industrialization and liberalization was the dominant ideology in politics, economy and industry. The guild system had been abolished in 1839, and In 1866, the crafts and industry in Norway were totally liberated (Jackhelln et al, 2019). Due to few opportunities, many Norwegians, like Tinius Olsen, emigrated to America to make a career. In 1875, he was already a successful engineer soon to start his own company on material testing in Philadelphia in 1880.

Most people in Norway were still employed in primary industries like farming and fishing, only about 2% in secondary industry (figure 1a). Fish, lumber and metals were the main exports, but Norway had become the third largest nation on shipping that counting for more the 40% of the national revenue. However, 1875 was a turning point. For the first time most contracted ships were with engine and many of the traditional shipyards for sailing ships went bankrupt. More shipyards for steam ships were established, and the first paper and textile industry had just been started. About 10% went to middle school, only 2% went to secondary school and most of them on general academic course (Figure 1b).

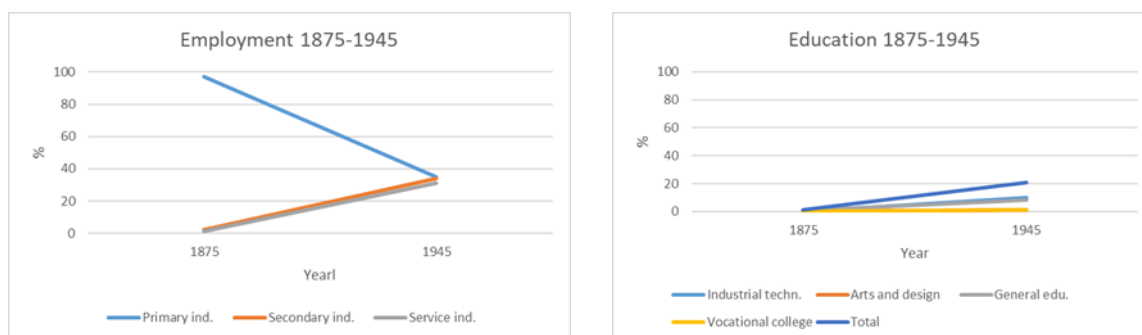


Figure 3.3. Employment vs. Education in Norway 1875-1945. Graphs compiled from national statistics

In the following decades extensive development of hydropower for electrochemical industry took place. Borregaard, established 1889, became a multi-national, company on paper, and Norsk Hydro a multi-national company on fertilizers and metals. Far later, also on oil and gas. For this industry, new skills technical were needed, but there were few or any alternatives for education.



Figure 4.1. Fertilizers from Hydro was a major export. In 1921, Hydro raised on of the first and most modern vocational school in Norway at the time, Rjukan Yrkeskole. (Photo: Norsk Industriarbeidermuseum)

Most of the period, the establishment and operation of vocational and technical schools were largely left to private initiatives (Ot.prp.nr.56, (1939), p.1). There were few or any national guidelines on the content of each schools, and on how to advance from one lower programs to advanced programs. Selected schools received financial support from the state and the local municipalities, but to varying degrees and often not predictably. The students had to pay tuition, and therefore most girls and boys in poverty were excluded to take further education.

A few vocational and technical schools already existed, like Kongsberg School of Mining (1866), Holmøy arbeidskole (1858), and a few technical schools. Drawing schools on Sundays and evenings were still the most common alternative for apprentices beyond basic education. However, in 1875 the government decided financial support of 3-year technical evening schools for apprentices. Most of the former drawing schools changed to a more advanced curriculum and became technical evening schools. However, when the craft industry in Norway was liberated from 1866, a craft examination was no longer required. Anyone could register for a certificate of apprenticeship, run a workshop and

start a business in any trade (Jackhelln et al, 2019). This led to many delusions and the quality of work deteriorate. To compensate for these problems, the government started to support a change of the existing drawing-schools to technical evening schools and elementary technical schools in 1872.

These schools were given a larger field of study and more teaching time. The first technical evening school was started in Oslo (Christiania). They were intended for apprentices working in a workshop or company during the daytime. Therefore, classes were held in evenings. However, Masters were still quite unwilling to hire apprentices. Therefore the Parliament decided to reintroduce the apprentice examination in 1881, but now as a voluntary scheme. However, when the Norwegian Joint Association for Crafts and Industry was established in 1886, they worked hard to make changes that led to a better apprenticeship scheme. Finally, a test of apprenticeship was reintroduced by law in 1894, mandating to obtaining a certificate of craftsmanship to start own business. Gradually more schools were started and became very popular. By 1940, 64 such schools were in operation across the country from Kristiansand in the south to Kirkenes in the north (Fagskolestatistikk, 1939-40, p. 14-15).

For women there were few or any alternatives. However, since the trade Act of 1842 single women were allowed to start business, trade and provide for themselves (Bergstrøm, 2013). After years of planning, the government gave support to the first school for women in 1875, Christiania Kvindelige Industriskole. At the end of the period, there were 2 more national schools (Fagskolestatistikk, 1939-40, p. 32). They were full time schools on daytime, but not linked to an apprentice system. They also they became more influenced by arts and aesthetic values than the technical schools, though there are some similarities in history and structure. Most of these schools were private, but some received small grants from the local municipality and local interests. The first school funded by the government was a school for women in Oslo, Christiania kvinnelige industriskole established 1875 (Aakre, 2005, p.97). When handicrafts became a compulsory subject in the 7-year folk school from 1889, the school also became a school for teachers in handicrafts for girls (Lov 1989), and became a school of higher education. A similar national school for men was started at Blaker in 1917. Today both schools are part of Oslo Metropolitan University and the majority of the students are teacher students of vocational and technical education, or in design arts and crafts.

This celebrated training centre for education in women's handicrafts. The Norwegian term "industri," in this case, implies art, diligence, and thrift, and has nothing to do with factory or mass production. (Lofffield, 1930, p. 66). The girls are taught the art of the various forms of tapestry and plain weaving, sketching, measurements, cutting and tailoring, pattern making, lace making, colour combination and vegetable's dyeing, embroidery, and all forms of needlework. They are also taught drawing, arithmetic, writing, bookkeeping, and the mother tongue. Lectures are given on the history of art and on the various phases of textile art and industry.

The technical evening schools were not regulated by law and they were dependent on local and private funds. They became popular and played an important role until they were changed to apprentice schools by law in 1940. They were started by private interests or local municipalities, and they had relatively great freedom to determine the content and method of the teaching. This led to differences between the schools. In 1912, the technical vocational schools got their first national guidelines “Normalplan”.

Many initiatives were taken to make a better system of vocational and technical education available for most young girls and boys. However, not until a political change took place in the 1930s, only a few concrete steps were taken.

From the beginning of the 20th century, the idea of day schools for apprentices was launched through the Vocational Schools Committee, which submitted its recommendation in 1906. The Storting's follow-up of the proposals in the vocational school committee led eventually to the creation of workshop schools. In the beginning, the state played no active role in the establishment of the workshop schools. It was first and foremost employers of craft and industrial that took initiative of the day schools to make sure young apprentices had some basic skills in both theory and practice before they were hired. The first such school was established in Kristiania (Oslo) in 1910.

There were several avenues for a profession in the interwar period. You could go to school first and get training in business later, you could get training in business at the same time as schooling, or take school after training in business. Workshop schools were offers about pre-school education in business, and these should give students basic theoretical and practical skills prior to learning. The basic course at the workshop schools was one year, but could be extended to a two-year high school or three-year workshop school. The schools in the apprenticeship are called apprenticeships, and they were usually three years old. Apprenticeship schools provided theoretical and practical training evenings. Everyone who signed a learning contract with one company committed to applying for apprenticeship as long as there was not too long distance between home, workplace and school. In the interwar period, several were created workshop schools in addition to a variety of vocational and preschool courses, but eventually they came to the realization that the many different paths to vocational competence varied too much in content, quality, length, and organization and not least, finance. Both funding and government grants varied between municipalities and school types. Some schools were private and funded by school fees from the students.

In 1933, the Vocational Training Council was established. Among other things, it got into task to clear the amount of different courses and schools within the vocational training. The Vocational Training Council's most important tasks were to assist the Ministry in matters relating to vocational schools and vocational training in crafts and industry. It turned including advice on setting up new schools,

preparation of teaching plans, running of exams, inspection and training activities and approval of textbooks.

3.1 Kongsberg and Type 1 programs (1875-1945)

At the end of the period, Kongsberg Technical Evening school established (1895) was the major school on secondary level (level 4). In addition there were four national vocational colleges (level 5): Kongsberg School of Mining, 2 years established 1866, Kongsberg School of forestry, 1 year established 1875, and the School of Supervisors for mechanical industry, 1 year established 1936. Details from the first two schools will be used as example.

Purpose and entrance policy

Kongsberg technical evening school (Kongsberg tekniske aftenskole) was established in 1895 and received state grants from 1897 (Ktf, 1897, p. 86-90). The purpose of the school was to “provide the students with the necessary knowledge for industry and crafts” (§1). Kongsberg municipality appointed board of four members for four years at a time (§6).

In 1899, the budget was 2.030 N.Kr and 20.940 in 1940. The Government covered 2/3, the municipality about 1/3 and the students had to pay school fee. However, every year the budget was too small and there were only little available for teaching materials until the school received a fund of about 110.000 from Tinius Olsen of Philadelphia USA in 1921 (IKA-1).

The budget for equipment and materials improved from 0, 1% to 20%. From 1924, Kongsberg received more fund of about 200.000 N.Kr. for a new Technical School. However, it took many years before this school, was realized in 1959

The head of the school and the teachers were well qualified with a college or university degree. The entrance criteria were minimum 14 years old and passed upper classes of 7-year folk school.

The school was called an “evening school”, held on evenings, from 7 pm to 9 pm five days a week. In that way, apprentices and student at work could attend the school without slowing down work during the day. However, less than 50% had an apprentice contract, many only a par-time job and some years more that 50% of the students had no job at all (table 4.1). This problem was often discussed, and

gradually leading to more and more full time vocational schools as “day-schools”. But the boom of such schools did not take place before after 1945.

Kongsberg School of Mining was a 2-year vocational college established by the government in 1866. It was a substitute for the College of Mining, established 1757, that had been transferred to Oslo University in 1811, and to Norwegian University of Technology in Trondheim in 1910. Its main purpose was to serve the local Silver Mines opened in 1624. It was also a national school of mining and after 1900 many of the applicants came from other parts of the country (Bergskolen, p. 32). The number of students were regulated by the needs of the mining industry. Therefor the number of applicants were far higher than the number of students.

Candidates had to be minimum 21 years old and minimum 3 years of relevant practice. The school practiced entrance examination with a competence level beyond 7-year primary school on language, mathematics and technology, for instance technical evening school. Only men graduated from this school (Table 4.1).

Tabell 4.1. Kongsberg School of Mining (Bergskolen)

Year	Applicants	Accepted	Graduated	Budget/Comments
<i>1867-69</i>	<i>?</i>	<i>8</i>	<i>8</i>	<i>300 spd.</i>
<i>1904-06</i>	<i>30</i>	<i>19</i>	<i>18</i>	<i>7 students from Kongsberg</i>
<i>1938-40</i>	<i>74</i>	<i>13</i>	<i>12</i>	<i>9.171 NKr</i>
<i>Attendance: > 95%. Only men graduated from this school</i>				

The school was financed by the government as a national school. Therefor the financing was good and stable. The students received pay 3 days a week when out in practice, and some years 25-30% of the budget was used for teaching materials and technical equipment (St. meld.nr. 31, 1936, p.7). 3.000 NKr from Tinius Olsens Fund was mention as an argument for Kongsberg against Trondheim as the location of the school, but not included in the budget.

Content and learning methods

The School of Mining and other vocational colleges had entrance examination on a level compatible with the technical even g schools. Many subjects were also the same, but to varying degrees (Table 4.2). Drawing was the dominant subject in the evening school and also the only practical subject. Practice were at work, for the students who had a job. Mathematics, science and technology were the

dominant subjects in the School of Mining that had 1 full year of practice integrated in the program. The role and amount of practice was a common theme in the debate on these schools for many decades. When the School of mining was reorganized in 1936, the majority argued in favor of a more theoretical school with practice on lab at the school instead of practice out in the field. They argued it was cheaper and easier to organize. However, the minority received support from the ministry of education:

“The Ministry is of the opinion that the Kongsberg alternative has advantages over the other that should be preferred. In particular, one would emphasize as a significant advantage that theoretical and practical teaching go hand in hand”. The minister of education, Nils Hjelmteit supported the argument when the matter was discuss by the Parliament (St.meld.nr. 31, 1936, p.7).

The minister of education Nils Hjelmteit was educated as a primary school teacher from Stord Normal School, influence by the progressive movement. In the new national curriculum for the 7-year folkeskole in 1939, he introduces “working school” as the overall learning method (Normalplan, 1939, p.16).

Tabell 4.2. Example Type 1 Programs in Kongsberg 1875-1945. Kongsberg Technical Evening School. Kongsberg Tekniske Aftenskole (Lessons estimated 1897-1945). (IKA-1)

Technical Evening School (NQF Level 4)		2-year School of Mining (NQF level 5)	
Subject	Lessons	Subject	Lessons
<i>Calculation</i>	20	<i>Calculations</i>	210
<i>Mathematics</i>	40	<i>Mathematics</i>	310
<i>Mechanics</i>	40	<i>Mechanics</i>	140
<i>Physics and Chemistry</i>	30	<i>Physics</i>	120
<i>Norwegian language</i>	20	<i>Chemistry</i>	70
<i>Freehand drawing</i>	40	<i>Geology</i>	130
<i>Construction drawing</i>	40	<i>Norwegian language</i>	160
<i>Design drawing</i>	40	<i>English language</i>	80
<i>Accounting</i>	20	<i>Electro-technique</i>	60
<i>Surveying</i>	-	<i>Machine technology</i>	100
		<i>Mining</i>	220
		<i>Processing</i>	40
		<i>Building and construction</i>	100
		<i>Surveying</i>	90
		<i>Management</i>	30
<i>Sum theory 10x10x3</i>	300	<i>Sum theory 3 days a week Mo-We</i>	1920
<i>Work/practical training 48x4x10x3</i>	5760	<i>Practice 3 days a week Thu-Sat</i>	1920
<i>Total 3-year program</i>	6060	<i>Total 2-year program</i>	3840
<i>Attendance rate: 93-96% (1940)</i>			

1) From 1897 to 1940, there were only minor changes. Physics and Chemistry were merged to Natural science, and Levelling was not continued in this school, but transferred to the school of mining. (IKA-1)

About teaching methods there are few or any documentation. From blackboard in school and practice in workshop. From 1922 the school was able to acquire teaching materials every year. This made it possible to demonstrate and to do practical experiments on labs. Equipment for electric and electronics like electric motors, generators, components and coupling materials were also purchased. This meant that the schools could emphasize electrical engineering in teaching and make practical experiments with it.

For each subject there was a final written examination. The tasks and the results by student name were published in the annual report. Most exams were on solving practical problems, but in mathematics there was also theoretical problems like solving equations to the first and second degree. For the final examination, the students had to make a journeyman piece to be approved by a committee.

Further education

The technical evening schools were the step-stone to further education at vocational college and Technical College and Technical University. In table 2, the Skienfjorden Technical School is used as an example. At this school, students could take extra courses for the marine industry. Other alternatives were one of three technical colleges and the technical university Trondheim, now the Norwegian University of Science and Technology (NTNU).

From 1936, a 1-year Vocational Colleges was added to the Kongsberg Technical Evening School. Its purpose was to educate Forman for the mechanical industry, often referred to as “Formannskolen” (Formannskolen, 1936).

3.2. Kongsberg and Type 2 programs (1875-1945)

At the end of the period there were three type schools in Kongsberg. Kongsberg Womens Industraila School (Kongsberg kvindelige industriskole) established in 1918 and Kongsberg School of Home Economics (Kongsberg husmorskole) established 1898. 15 km outside Kongsberg there were also a Folk High School established in 1906. For many years this school also had crafts (sloyd) for boys and home economics for girls (Bukskerud folkehøgskole, 2020).

Kongsberg kvindelige industriskole (1918-1940)

The school for women in Kongsberg, Kongsberg kvindelige industriskole, was started in 1918 with 48 students in ½-year courses (KKI, 1918). The name of this school was inspired by the first schools for women like the Christiania kvindelige industriskole in Oslo, established 1875. However, it is also an example of these schools that did not include theoretical subjects like language, mathematics and science in their curriculum. The necessity of such theory had been a controversy for a long time and there were no national guidelines like the “Normalplan” for the Technical Evening Schools (Loftfield, 1930, p. 66). Therefore, this school had no link to further education. If they wanted to earn for a certificate of apprenticeship and a Meister, they had to start from the beginning as apprentice and take the required theory in an evening school. This school was integrated with Tinius Olsen School in 1963, adapted to a 1-year program adapted to the apprentice system.

On the other hand, the main purpose of this school was to educate girls for family life and home economics, and some possible extra income from doing work from home. The goal was not to become an employed dressmaker in a workshop or to be a Meister with own business. Most girls at the time were still supposed to be good wives and mothers to care for their family in their homes. As stated in the plan for the school, “the purpose of the school is to educate women in practical work, suitable for riverine work, and for the benefit of the home” (KKI, 1918 and 1938). The important role of the house-wives and home economics at the time, were also expressed in the advertisements of the school (KKI, 1925).

The school was owned and financed by Kongsberg municipality, but the students had to pay tuition and the materials they used. However, the school also received some grants from the government every year, and some grants as scholarships to poor students.

Purpose and admission requirements

The purpose of the school was to educate girls for tasks at home and if possible extra income from sewing clothes on assignments from home. Or as it says in the plan: "The purpose of the school is to educate women in practical work and for independent work and for the benefit of the home" (KKI, 1918 and 1938). The important role of housewives was also emphasized in the school's advertisements (KKI, 1925). The goal was therefore not to become and be employed as a dress and costume tailor in a workshop or to become a tailor with his own business.

The school was owned and financed by Kongsberg municipality which established a board for the school with 3 members from the womens counsel “Kinderaadet”. The students had to be at least 15 years old and students from Kongsberg had priority. They had to pay for drugs and other materials they used. However, the school received some grants from the government every year, and some of the grants were used as scholarships for students with poor advice.

Content and learning methods

In these schools students learned through practice and by doing. There were no separate class on theory, but integrated in the practical training. The students received help and counselling from the teacher while working on concrete tasks.

Table 4.3. Example Type 2 Programs in Kongsberg 1875-1945. Kongsberg Women Industrial School. Kongsberg Kvindelige Industriskol. Lessons estimated (1918-1945). (IKA-2)

1/2-year day School (NQF Level 3)		2-year Vocational College (NQF Level 4-5)	
Subject	Lessons	Subject	Lessons
1. <i>Linen sewing Linen stitching with stopping, lapping and measuring, calculation, drawing and cutting.</i>	340	<i>No link to alternatives as there was no specified classes on theory. A possible alternative was to have an apprentice contract, attend 3-year technical evening schools and take a journeyman diploma as dressmaker. After that take a Meister or go to a vocational college like the national academy of arts and crafts.</i>	
2. <i>Dress sewing Dress stitching with measurement, calculation, drawing and cutting. Both subjects with drawing</i>	350		
<i>No separate subject in language, calculation or bookkeeping</i>	0		
<i>Sum theory (Integrated)</i>	0	<i>Meister: language, calculation, accounting</i>	
<i>Sum practice in workshop</i>	720		
<i>Attendance rate: 93% (1938)</i>			



Figure 4.2. Dressed for celebrating May 17.

There were a variety of products, some according to contemporary fashion. There were Mannequin show in the evening between 7 – 8 am. “Beech pajamas for distant beeches” and “smoking jackets” (røkejakke) and “sports-jeans” were among the collection. There were collections for the different seasons like anorak for skiing in the winter, summer blouses and jackets (IKA-2). Complete costumes for children to celebrate the constitution day on May 17 were also among the products made by students (Figure 4.2). This indicates that the main purpose of the school was to teach skills useful in the household.

For the anniversary in 1938 reflected that the depression of the 1930’s was over. There were money available for many kinds of textiles, and the students expressed modern fashion in their products. A few years later during the war and short after, basic skilled training and to be made by paper.

The products they made served as a kind of journeyman piece and the students were evaluated on the basis of the products they made. Every year students had to present their products on an exhibition open to the public, and the evaluator attended to evaluate the work of each students. The main product of the year served as a journeyman piece and listed in the Diploma, though not qualified as a certificate of apprenticeship. The annual exhibitions in December and May were popular events published in the local newspaper, and there were reports from the “cat-walk”.

Schools of home economics schools (husmorskoler), or technical schools for domestic arts (fagskoler i husstell) arose at the end of the 19th century for the purpose of providing specialized instruction in domestic subjects. The schools developed in parallel with agricultural schools (landbruksskoler) and were intended to teach food preparation and housework. Later these home economics schools were also established in Norway's cities. The schools in the countryside were generally governed by county councils (fylkeskommuner) and town schools by municipal governments.

3.3. Other vocational or semi-vocational programs (1875-1945)

At the end of the period 1875-1945, vocational educations of varying length and quality were established, adapted to most industries and occupations that were important at the time. But one profession remained: fishing and hunting. Admittedly, the modernization of fishing boats with engines was well taken care of by the seamen's schools and the technical education at the vocational and vocational school. In 1938, however, the State Vocational School for the fishing industry in Vardø was

established. It became the first vocational school in the fishing industry. The year after another vocational school for fisheries was established at Aukra in Romsdal.

After World War II, there were more schools and programs on fishing, later as separate programs under the “umbrella” of vg1 nature management *Naturbruk* (Udir, 2020).

3.4 Norway at war 1940-45

On April 9th 1940, Norway was occupied by Nazi Germany. The new on vocational education for crafts and industry was not implemented until after the war (Lov, 1940). Many school buildings were confiscated for other purpose that schools, and there were lack of materials and iqupiment.

However, on May 8th 1945, Norway was liberated after five years of war and occupation. The northern part of Norway was left desolate after the Germans had used the tactics of the burnt earth (Figure 4.2 left). Further south, several cities were bombed and there was an acute housing shortage, and many businesses and industries were down. The first task was economic recovery and to rebuild the country and



Figure 4.2. Berlevåg 1945 (left). Northern part of Norway was burned down by Nazi Germany. Deuterium (right) produced at Hydro Rjukan was a key in the rush for an atomic bomb. (Photo: Nasjonalbiblioteket og Norsk Industriarbeidermuseum)

5. Social democracy and integration (1945-1980)

The relative production in Norway increased from 100 in 1938 to 107 in 1940. After the war broke out in 1940, the production index dropped to 56% in 1945 (NOS. X. 154). There were shortage on most goods from food to materials and industrial products. Education, especially vocational education, had been closed down and many young students joined the resistance movement. The northern part of Norway was left desolate after the Germans had used the tactics of the burnt earth. Further south, several cities were bombed and there was an acute housing shortage, and many businesses and industries were down. The first task was to rebuild the country and economic recovery.

The first part of the period includes the transition from war to peace economy, currency remediation in 1945 and the winding-up of the war-years regulations (Bjerve, 1964). Restoration of the country's production capacity and the war-torn districts the stabilization of the economy was needed. Full employment to rebuild the country had first priority. Fortunately, the recovery of the Norwegian economy improved much faster than the experts predicted in 1945. Already during 1946 GDP per capita was higher than in 1938. In 1947 GDP per capita was larger than in 1939. In 1960 the production index had improved by 107 %, and the period between 1950 and 1970 is often referred to at the golden age of industry in Norway. At the end of the period, oil and gas were found in the North Sea and Norway became an oil-nation that led to restructuring of industry and education. Service industries took over and outperformed the traditional industry (Figure 4.1a).



Figure 5.1. Employment vs. Education in Norway 1945-1980. Graphs compiled from national statistics.

Shipping, paper, metals, electrochemical products and fish were still main industries for export. However, there were many innovations on new segments on consumer technology. Tandberg Radio, established in 1933, became a global company on high quality electronics on the consumer market with Hi-Fi receivers, amplifiers, speakers and tape-recorders. One example, the Sølvsuper 12 FM tuner and amplifier is shown on figure 4.1. Electronics soon became popular programs in the new vocational and technical schools.



Figure 5.2. Tandberg Sølvsuper 12. (Photo: Nasjonalmuseet, OK-1994-0044)

Little Christmas Eve 1969, oil was discovered at Ekofisk in the North Sea, the largest oil fields ever found at sea. Production from the field started on June 15, 1971. This changed the focus of industry in Norway dramatically. Research and high skilled engineers and workers were set to solve the many new and complicated tasks of extracting oil from the seabed under extreme weather conditions. But the outlook and salaries was good. It changed the entire society and many traditional industries were closed down in the 1970s.

Prominent politicians wanted to join the European Economic Community (EEC). But the people voted “No” in the 1972 referendums. The prospect of large oil revenues may have been a contributing factor. Instead, there was an agreement on trade that had little effect on the labor market, regulations and education in Norway

From 1945 the government started to invest heavily on education and to implement the law of 1940. The national spending on education increased from 2% to 5, 8 % of BNP from 1950-1970, and there was a strong commitment to the human capital theory. A boom on education took place and the fragmented school systems was integrated to one system of 3-year upper secondary education by the new law of 1974 with a combination of both vocational and academic programs (Law, 1974).

In 1945, the Labor Party (AP) had been in power since 1935, and continued to stay in power most of the period until 1981. Their ideology was an active state and a balance between government and private initiative. Free education for all was one of their main priorities. But, the fragmented structure of schools and programs, private and government owned, called for better regulation. Soon the first national law on vocational and technical education was adopted (LOV-1940-03-21). The new law included all vocational education and training before, during and after apprentices, as well as vocational schools and technical colleges.

“The schools should be organized so that students can work towards higher vocational education through the various stages of teaching and learning supported by practice”. (§1 translated by author).

A state loan fund was established to ensure that as many as possible could take education, regardless of financial position or social status. Companies who offered apprentice contracts also received grants from the government by a new law of apprentices (LOV-1950-07-14). The law included new skills such as commerce and trade, and made it more flexible as to how and when to fulfill and register for the apprentice examination. The former technical evening schools were changed to apprentice school, and a new type of schools (yrkesskole) became the model for vocational education with full time theory and practice in school on day-time. From now on teenagers without a job could start further education from primary school, played by the government. The new law of Apprentices was also made more flexible so that students could combine training in school or company more easily

“The company shall ensure that the apprentice receives thorough training in accordance with the applicable training plan ... and to ensure that the apprentice participates in the compulsory education in a vocational school”. (§8 translated by author).

This statement was identical with a decision on the congress of the Labor Party in 1936 (Aakre, 2005, p.102) (NSD, 2000, Ap_1936. However, the next decades were characterized by solidarity and coordination, not school reforms separating social classes. By 1974 all secondary education was included in the same law. The reason was the unification during of the people during ww2.

The policy before the war was to establish two parallel and equal educational tracks, one academic and one technical, from apprentice training to university. However, the war had created greater unity in the population and one gradually departed from a class-divided school system (Aakre, 2005, p. 102). After a long process of coordination and integration, all secondary education was brought together in the same law in 1974 (LOV-1974-06-21-55). The idea of integrating both vocational and academic studies in the same school. A typical example of this period is Tinius Olsen School in Kongsberg,

A state loan fund was established to ensure that as many as possible could take education, regardless of financial position or social status. Companies who offered apprentice contracts also received grants from the government by a new law of apprentices (LOV-1950-07-14). The law included new skills such as commerce and trade, and made it more flexible as to how and when to fulfill and register for the apprentice examination.

In 1945 the structure of schools was the same as before the WW2. But soon the law of 1940 was implemented (Lov, 1940). The former Technical evening school changed status to apprentice schools only for students who had an apprentice contract. The next 30 years the new type of vocational schools (yrkesskole) had high priority and new schools were raised in most cities around the country. By 1970 there were 731 vocational schools (NOS, 1970, p. 12). The majority was in crafts and industry (218), commercial and trade (151), and health care (110). Maritimes schools (53) were still independent schools, but gradually to be integrated with regular schools.

In 1970 about 50 % of the applicants to craft and industry programs were accepted, to the maritime schools about 83%. However, to the schools for schools of health and social services only about 20 % of the applicants were accepted, and the majority of the applicants were women (NOS, 1970, p. 25). There were also major gender differences between the various programs. Table 5.1 shows estimated data from three different program areas. “Hard” programs like Technology and Industry were dominated by men. “Soft” programs like Health and Child Care were dominated by women.

Table 5.1. Gender differences in 3 Vocational programs in Norway 2019 (NOS, 1970)

Program	Accepted	Men		Women	
<i>Technology and Industrial Production</i>	51,1%	29904	79,7 %	7377	21,3 %
<i>Design and Crafts</i>	31,7%	94	5,6 %	1586	94,4 %
<i>Health and Child Care</i>	20,8%	829	9,6 %	7745	91,4 %

In the 1960s, extensive reform work was started with the aim of bringing all upper secondary education into one common system and a common law. The idea of parallel and separate school systems as proposed by the 1940 Act was abandoned. Inspired by the high schools in USA and the school reforms in Sweden the idea of a common secondary school with all programs became the ideal. In 1974 the reform process was completed and the new law was passed by the Parliament (Lov, 1974). A new common national curriculum was also drawn up and all courses and subjects arranged in 9 different programs.

After 1945 there was more and more attention to the fact that Norway is not a completely mono-cultural society. There has always been two peoples, Norwegians and a minority of same with their own language, culture and special crafts, the *doudji*. In 1952 the first schools for Same was established in Guovdageaidnu (Kautokeino). In 1976, two programs were established under the new law of upper secondary education (Lov, 1974): Program on Crafts and industry (*type 1*) and program on Arts, crafts and design (*type 2*) with and *doudji* as a unique traditional same crafts (Aakre, 2005, p. 187).

In the 1970's there were also a growing number of immigrants to Norway. The majority from Pakistan and Turkey who came to take low skilled work not so popular by Norwegians.

5.1. Kongsberg and Type 1 programs 1945-1980

In 1945 there were 3 type 1 schools in Kongsberg: Kongsberg technical evening school (3 year), the Forman school (1 year), the School of mining (3 years), However, they were operating according to old plans not in accordance with the Law of 1940 and the comprehensive reforms adopted by the Storting in 1939 (Ot. Prp. 59). The national ambition was to develop an integrated system of schools from apprentice to technical university, and the priority was 1-3 year full time vocational schools and 1-3 year technical colleges and a 4-year technical university. Based on the same law, Kongsberg vocational school (yrkesskole) with full time classes at day-time was started.

A young engineer, Kolbjørn Hegstad who had spent the war-years with the resistance movement, was at the forefront of this pioneer work. By bicycle he recruited the first class to the school in 1946. Soon he became head of the 1-year vocational college as well. By 1970 he was head of an integrated school with students from apprentice training to college engineering (Figure, 4.2). Hegstad was also called upon to organize Vocational education (Yrkesskole) on Iceland (IKA-4, 1958).

Consequently, vocational and technical education in Kongsberg also expanded and changed into new technologies (Figure 4.2). A new and modern school building was erected to accommodate the many new classes. The new school was financed equally by Tinius Olsen fund and grants from local and national government, named Tinius Olsens School.

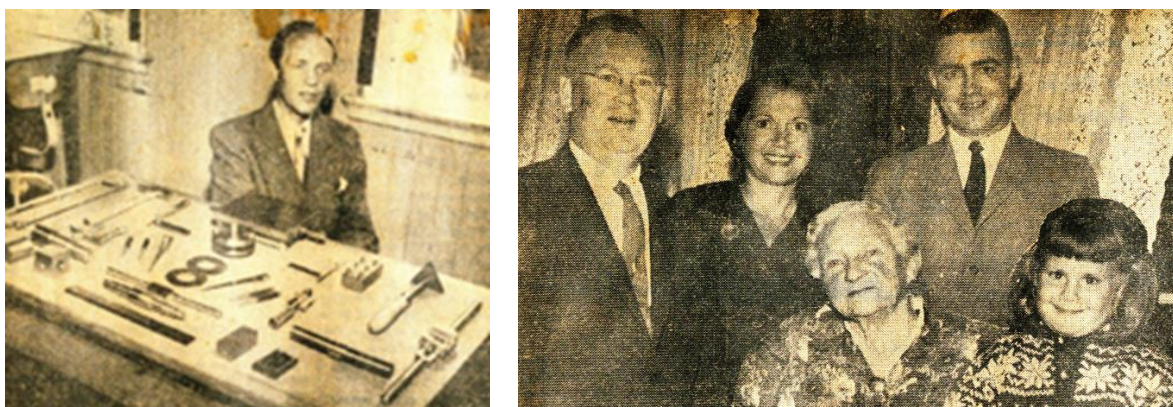


Figure 4.3. Principal Kolbjørn Hegstad (right) with a collection of Journeyman pieces in 1957. Tinius Olsen 2nd (right) and his family visiting Kongsberg. His wife Janet and daughter Jane. A family member John A. Millane who became the President of Tinius Olsen Testing Machine Co. in 1974. In the middle Mrs. Fusche, wife of former Rector. (IKA-5, 1957)

From the 1950's, Servo and Cybernetics became key words in Kongsberg and major structural changes took place. The silver mines were empty and closed down. The defense industry changed from primarily mechanical production of guns and cannons to advance control systems. They were complex systems combining mechanical, electrical and computer technology. The first computers were analog servo systems, but soon in the 1960's the first digital computers were produced and put into a variety of products. KV at the time, now Kongsberg Group, expanded and the turnover increased by a factor of 10 from 1960o 1980.

Spinoff from this industry also became a step-stone into the oil industry in the 1970's. Dynamic positioning (DP) became one of the successes now used in a variety of ways. DP is a computer-controlled system to automatically maintain a vessel's position and heading by using its own propellers and thrusters. Position reference sensors, combined with wind sensors, motion sensors and gyrocompasses, provide information to the computer pertaining to the vessel's position and the magnitude and direction of environmental forces affecting its position.

Principal Kolbjorn Hegstad and his staff was among the most innovative educators in Norway at the time. The school expanded rapidly on many fields of vocational and technical education. The key factor was close partnership with the industry, to respond to their needs and design programs relevant for new jobs. Soon there was a variety of programs from apprentice training, vocational courses, technical school and college of engineering.


Tinius Olsen School 1970	Programs	Started	Classes	
	<i>3-year College of engineering</i>	1963	3	
	<i>2-year College of engineering</i>	1963	3	
	<i>2-year Vocational College</i>	1965	2	
	<i>1-year Vocational College (Foremen)</i>	1950	1	
	<i>Advance class Servo Electro</i>	1961	1	
	<i>Advanced class Electronics</i>	1960	1	
	<i>Advanced class Machining</i>	1960	1	
	<i>Advanced class Toolmaker</i>	1960	1	
	<i>Basic class Metalwork 1-year</i>	1946	6	
	<i>Basic class Textile work 1-year</i>	1918	1	
	<i>Evening School for Apprentices</i>	1895	1	
	<i>Attendance: 96,7 %</i>			

Figure 4.4. Tinius Olsens School and its classes in 1970. (IKA-6, 1970)

From figure 4.4 we notice that the original Technical Evening School from 1895 is reduced to only 1 class with only 8 students. The most common track was now 1- or 2- year vocational program in school before apprentice contract and further practice before apprentice examination after 1 or 2 more years.

The original school for women started 1918 was now integrated as a 1-year basic course on a 3-year program for Dress-makers. We also notice that subjects like electric, electronics and servo were new innovations during the 1960's. The college of engineering also reflect this new trend. Cybernetics and computer science was implemented in the late 1960's, first with analog computers and soon with digital computers.

Content and learning methods

From table 5.1 we notice that the vocational classes had practice in labs. Business organization and book-keeping were also compulsory subjects. On the engineering classes we notice they did not have traditional labs, but four modules of project work where the students formulated and solved real-life problems and put their ideas into practice. Tinius Olsen School was probably the first school next to the Technical University in Trondheim to introduce such learning methods.

Table 5.1. Example of Type 1 Programs in Kongsberg at Tinius Olsens School 1945-1980.
From Advanced Servo Class to Technical College in 1970. (IKA-6).

Secondary level (NQF Level 4)	Mod	College level (NQF Level 5-6)	Mod
Class: Adv. Electro- and Servo Technology	*)	Class: Servo Mechanics	*)
<i>Mathematics</i>		<i>Mathematics I and II</i>	
<i>Mechanical technology</i>		<i>Physics and Chemistry</i>	
<i>Drawing</i>		<i>Technology I and II</i>	
<i>Material technology</i>		<i>Mechanics I and II</i>	
<i>Electro-technique theory</i>		<i>Electronics and analyses</i>	
<i>Electro-technique lab</i>		<i>Electronics and digital technology</i>	
<i>Electronics theory</i>		<i>Technical programming</i>	
<i>Electronics lab</i>		<i>Cybernetics and Laplace analyses</i>	
<i>Synchro- and Servo technique</i>		<i>Hydraulics and pneumatics</i>	
<i>Electro measurements theory</i>		<i>Instrumentation</i>	
<i>Electro measurement lab</i>		<i>Analog computers</i>	
<i>Cybernetics</i>		<i>Economy and management</i>	
<i>El-machines</i>		<i>English and German language</i>	
<i>Business organization</i>		<i>Projects</i>	
<i>Book-keeping</i>			

*) Modules or lesson hours not available

Tinius Olsens School was not only innovating in starting new studies, but also on experimenting and introducing new ways of teaching and learning. The introduction of project based learning (PBL) is already mentioned. Some of the ideas Rector Kolbjoern Hegstad and his Assistant rector Karl Schoenning-Andreaasen learned from a study trip to USA in 1967. "In America they start to use computers in 5th grade" they reported and asked the rhetorical question: "is time to leave the old orthodox classrooms with the traditional desks on a row?". More flexible and creative teaching and

learning methods were intridused. To learn English the first language laboratory based on Tandberg tape recorders wer installed in a separate room.



Figure 4.5. The Open Classroom, by Hegstad and Schönning-Andreassen (IKA-7, 1968). The Dynamic school: Drawings by Karl Schönning-Andreassen on Adaptive Learning (Ingeniørnytt 22.5.1970)

Soon classes for the oldest students were changed to lectures with 100 students and more, seminars with counselling in small groups of 10-12 students and self-studies in colloquiums. Senior Lecturer Schoenning-Andreassen used logics and cypernetics to explain and promote the ideas of the “dynamic school” at and outside the school in seminars and conferences (Ingeniørnytt, 22.5.1970). The dynamic school he explains, is adaptive to the intersts of the styudents and the demands from society and industry. Feedback. He was also the first Norwegian who had a scholarship to study about technical education in Japan when he visted Tokyo and Osaka in 1973. He also introduced projects in addition to the traditional exams.

In addition to more democratic learning styles, ther were more focus on ergonomy and and humanistioc management in modern industry. The idea of democracy at work, quality circles, creativity and job rotation were introduced, inspired by the experiments and research of Einar Thorsrud (Emery & Thorsrud, 1976).

The idea of Assessment for learning was introduced in the Norwegian schools from about 2010, (Aakre, 2913). Teachers were also trained for this strategy. There are no research on the effect of this strategy but teacher of vocational and technical education report they practice this strategy.

5.2 Kongsberg and Type 2 Programs 1945-1980

The Kongsberg female industrial school (Kongsberg kvinndelige industriskole) continued as an independent school and followed the same ½-year program since it was started in 1918. But in 1963 it

was adapted to the law of 1940 as a 1-year vocational school and merged with the new Tinius Olsen School. From now on the students were able to continue on further education to become profession dressmaker and also Meister to open and run own business. There were no such alternative in Kongsberg, but some qualified for teacher education and became teachers of arts and crafts in Primary school, or on textile in secondary school.

Table 6.2 Example Type 2 Programs in Kongsberg 1945-1989. Taylor Class (Søm) at Tinius Olsens School 1970. (IKA.8).

Secondary level (NQF Level 4)	Mod	College level (NQF Level 5)	Mod
Class: 1 st year Sewing	*)	Class: Meister Dressmaker. 1)	*)
Norwegian language	72	Professional management for aesthetic crafts	
English language	72	- Contracts, calculations, HR, etc.	
Mathematics	72	Customer care and service management	
Drawing	144	- Service, communication, ethics, etc.	
Vocational theory of textile		Production and services	
Sewing patterns		- Innovation, production, QA, etc.	
Textile design and technology		Projects and project management	
Workshop		- Planning, leadership, economy etc.	
		Project	
		Minimum Certificate (3 years) and 1 year practice	

There were, and still are no vocational college for this category of students in Kongsberg. Therefore Oslo School of Fashion is used as an example in Table 4.2.

5.3 Other vocational and technical schools 1945-1980

Until 1974 the Maritime schools had been operated as separate schools, some partly funded by the Shipping association. In 1974 they were integrated with national schools under the same law, though it took some time before all schools were integrated. The maritime schools also included Maritime vocational colleges that was integrated with vocational technical colleges.

Between 1970-80, the service sector outperformed the traditional industry (Figure 4.1a). This is also reflected in education as the separate schools on home economics, health care and child care were integrated in the law secondary education in 1974. In Kongsberg the former School of home economics were changed into a secondary school by the name Dyrmyr Secondary school with a variety of programs. In 1974 a program on domestic helper was started in collaboration with the school of nursing (Dyrmyr, 1999).

The former 2-year vocational school of mining was continued, but moved to Trondheim as a national school of mining in 1966, after the Silver Mines in Kongsberg were closed. The vocational school of forestry was changed to a preschool for the University of Forestry, but closed down in 2000. As a supplement a vocational school of forestry (Level 4) was established in Saggrenda outside Kongsberg in 1965 – 74 - 75. This school was integrated vocational school (yrkesskole) with the system of 3-year secondary education in 1974 (Lov, 1974).

Kongsberg never had any Folk High School, but one in the neighboring municipality of Øvre-Eiker and one in Rollag. Nationwide the number of such increased to about 75. From 1948, they were regulated by a separate law which, among other things, ensured some of you distinctive boarding schools and without exams (Laws, 1948 and 2002).

6. Postmodernity and neoliberal trends (1980-2020)

Norway in the 1980's., like most industrial nations in the West, struggled with inflation unable to control, drastically reduced growth, less productivity, and unemployment that did not happen since the 1930's. The number of people in traditional industry went down, and the service sector continued to increase (Figure 5.1.a). Traditional low-skill industries and companies producing consumer goods closed down due to competition from abroad. Especially from Asia on cloths, consumer electronics, etc. Most western countries faced recession, finance crises and unemployment. Norway had to restructure its economy towards a more knowledge-based industry. For this purpose, the quality, content and length of education on all levels had to be improved (Figure 5.1.b)?

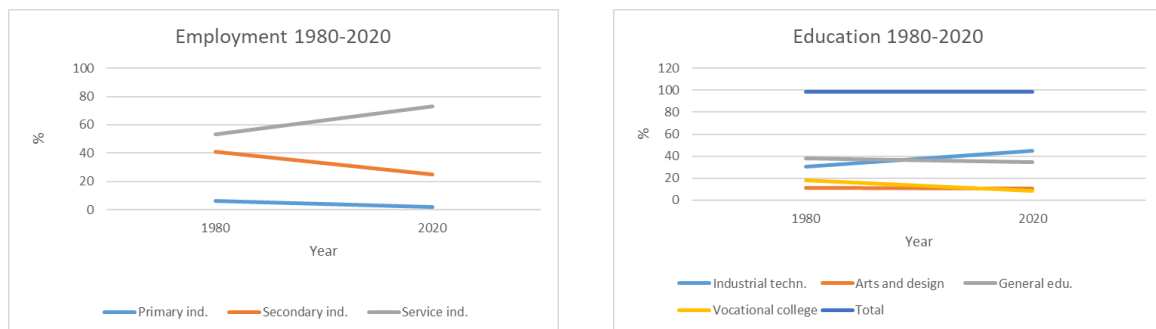


Figure 6.1. Employment and education 1980-2020. Graphs compiled from national statistics

Faced with these problems governments were almost paralyzed. The classical planning and regulation philosophy that was a great success after ww2 did not work anymore. The politician lost a significant precondition for being able to act. The deputy leader of the Labor Party, which had ruled Norway almost continuously since 1935, initiated the party's national meeting by saying:

“We live in a time when people are uncertain about the way forward. Pessimism prevails in the modern industrial society ... At the same time we see that some countries doing better. One of them is Japan” (Førde, 1981, p. 57). (Comment by author: Before the recession in Japan)

Førde admitted that he had no clear answer to the problems or the way forward. The Labor Party lost the election and a conservative government led by Kaare Willoch took over. Norway followed a world-wide neoliberal trend with deregulation and more private initiatives, but less dramatic than in other countries such as the UK and the USA. Even the Labor party adopted the new ideology when they returned in power in 1986. One example was the abolishment of apprentice certificate as a requirement to start and run a business. A similar discussions appeared a hundred years before (See chapter 3).

During the 1970’s many traditional industries closed down due to competition from low-cost countries, especially on commercial products like clothing and footwear, but also commercial electronics and home appliance. A few textile companies like Helly Hansen, established in 1877, survived through research and transfer to special outfits for work and leisure activities under extreme conditions (Figure 6.2, left). Industries like Kongsberg turned to the oil industry and used complex mathematical model to develop special systems to operate ships and platforms at sea (Figure, 6.2, right).



Figure 6.2. Innovations by Helly Hansen (left) and Kongsberg (right)

One of the deregulations was a new revenue system (DNI) for the municipalities, introduced in 1986. A new financial responsibility principle and a changed financial subsidy scheme in the transfer from the state to the municipalities was adopted (Stortingsmelding no. 26 (1983-84)). The system gave municipality’s greater freedom in their internal prioritization of money for education, health care and

other services. This eventually led to greater financial differences between the schools (Storting Report no. 28 (1998-99)).

Another deregulation was abolished the additional bank reserve requirement. In the mid-1980s, there was strong growth in the Norwegian economy from the oil and gas sector, and loan-financed consumption and investment increased. The banks and other branches expanded greatly, including with new branches. When the oil prices fell dramatically in 1986. The stock market crash was followed by a general economic downturn, partly because Norway had been slow to adopt and implement new technologies.

The shipping industry had been in deep trouble since the 1970's. More and more shipping companies registered their ships abroad and hired cheap labor from low cost countries like Philippines. In 1987 the Norwegian International Ship Register (NIS) was established to separate rules on wages and taxation. Maritime education was also changed and some training was outsourced abroad like the Norwegian Training Center Manila (Aakre, 2015). Today there are very few Norwegian apprentices on Norwegian ships under NIS, and also very few sailors.

The majority in both the Labor Party, with Prime Minister Gro Harlem Brundtland (AP) at the forefront, and the Conservative party (H) argued that membership in the EU would help ensure continued economic growth and prosperity for Norway. However, like in 1972, the majority voted "No" in the national in 1994. Instead a special agreement was adopted through the European Economic Area (EEA) accepting most of the four freedoms: free movement of goods, capital, services, and labor. In the coming years, many companies chose to import cheap labor from EU, especially from Eastern Europe. This changed the labor market quite dramatically, and also vocational education. The concept "social dumping" is still discussed as one reason why education for crafts like building and construction has been low for more than two decades.

In spite of liberalization, the ideas of the "Welfare State", with free health-care and free education for all, continued to have widespread support from all political parties and alternating governments from left and right. There is a lower class of poor people who have not benefited from the development of wealth over the last decades, but a relatively small group. One example is a growing percentage of children in poverty increased from 4-5% to more than 10% in a few years.

Comprehensive reforms in education by adopting and integrating digital technology on all areas was needed to recover. The major reform of secondary education was implemented from 1994, based on a new law in 1998 (Low 2018). Two more minor curriculum reforms were also adopted, one in 2006 and the present reform one from 2020. Finally, Vocational colleges were also regulated by a state law from (Law, 2018). To be financed by the government Vocational colleges also had to be accredited by Norwegian Agency for Quality Assurance in Education (NOKUT). In the future, accredited

Vocational colleges may become 3-year-programs with the title of “Meister” at the same level as a 3-year bachelor from a university (NOU 2014:14).

Most young people took upper secondary education, and many new advanced vocational courses were established (figure 5.1b). During the 1980’s more and more advanced classes were started so that students after one more year did not need to go back to apprentice school for more supplementary theory. In some cases 3-year programs in school were also started, but in Kongsberg and other places with vocational colleges many students from second year transferred directly to the 2-year technical college.

At the same time a new law of apprenticeship was adopted including more and new crafts and trades, and with a better organization (Lov, 1980). The number of contracts increased because of higher salary for the apprentice and higher compensations for the companies offering contracts.

However, a fragmented structure of vocational programs allowed few to complete a 3-year program in the same field. Therefore, comprehensive reforms were implemented in the 1990s (Lov, 1998). The right to upper secondary education (NQF Level 3) was legislated: all youth between the ages of 16 and 19 should have the right to three years of education that could lead to a crafts- or journeyman certificate (*Type 1*), a general diploma (*Type 3*) or documented sub-competence. However, there were still mixed programs and subjects that did not fit into this frame, referred to as *Type 2* programs in this study.

The total number of basic programs were drastically reduced and merged into 13. The new law covered both primary and upper secondary education, as well as apprentice training in a workshop or business (Lov, 1998). For most vocational programs the structure became 2 years in school (vg1 + vg2) and 2 years of apprentice training (vg3), often referred to as the “2+2 model” (Udir. 2011). This structure was maintained with few changes in the last renewal 2020. In this reform some new interdisciplinary themes are adopted for both general and vocational program, reflecting contemporary problems: democracy and citizenship, sustainable development, public health and life management. Critical thinking to counter fake news is also emphasized.

At first vocational colleges (level 4-5) were regulated by the same law, but later a separate law was adopted in 2003 and replaced by a new law in 2018 (LOV-2003-06-20-56; LOV-2018-06-08-28). From January 7th 1977 the former Colleges of Engineering (level 6) were transferred to the state to become a new system of higher education, but not regulated by law until 1988. These colleges were required to do research in their own professional field. After a new law of universities and colleges in 1994 (LOV-1995-05-12-22; LOV-2005-04-01-15), followed by an extensive coordination and integration, most of the many colleges were eventually accredited to a few universities (Level 6-8).

Table 6.1. Upper Secondary School Programs after Reform'94 in Norway (1994-2020)

Type 1	Type 2	Type 3
<i>Building and Construction</i> <i>Electricity</i> <i>Design and crafts</i> <i>Health and youth development</i> <i>Agriculture, fishing</i> <i>Restaurant and food subjects</i> <i>Service and transport</i> <i>Technical and Industrial</i> <i>Production</i>	<i>Sports</i> <i>Media and Communication (1)</i> <i>Music, dance and drama</i> <i>Design and crafts (1)</i> <i>(Listed as Type 1)</i> <i>Art, design and architecture (2)</i> <i>(Elective subject in Type 3)</i>	General program with specialization in subjects

Notes. 1) Defined as a Vocational programs, but few apprentice contracts. Transfer to diploma from general program. 2) Originally a Vocational program from 1994-2016, but a special program from 2016 with diploma from general program.

Content and learning methods

Table 6.2. Structure of Curriculum and Contents

Content	Lessons	Subjects
<i>Basic skills</i>	<i>Integrated</i>	<i>Oral skills, Reading, Writing, Digital skills, Numeracy</i>
<i>General subjects</i>	336	<i>Norwegian language, English language, Mathematics, Natural science, Social science, Physical Education</i>
<i>Program</i>	447	<i>Depends on program. See examples</i>
<i>Vocational specialization</i>	168	<i>Local preparation for work</i>

“Vocational specialization should help introduce students to working life, and give regional and local working life the opportunity to define the content of the training in line with local competence needs based on curricula for relevant subjects” <https://www.udir.no/laring-og-trivsel/lareplanverket/finn-lareplan/yrkesfaglig-fordypning/>

5.1 Kongsberg and Type 1 Programs (1980-2020)

In 1980, Tinius Olsens School was an integrated school with vocational, technical and academic programs under the new law of secondary education of 1974 (Lov, 1974). But the school was split up between different government levels. The 2-year Vocational College (fagskole) was continued, but the school of engineering was separated to become an independent college of engineering (KiH) from January 1977, and regulated by the law of higher education from 1986 (Lov, 1986). In 2015 the Vocational College (Fagskolen Tinius Olsen) and the Faculty of Engineering was merged at the same campus “Krona” (Figure 6.3), now hosting University of South-Eastern Norway (USN).



Figure 6.3. Krona. The new campus for University of South-Eastern Norway (USN) and Tinius Olsen Vocational College (Fagskole) from 2015. President C. Robert Tait III and Principal Finn Simensen (right) (Photo: USN).

On secondary level, now called Campus Tinius Olsen, the school continued to expand during the 1980's and 90's. Digitalization and communication became the new changing factors. In 1982 computer science and some basic programming became an elective subject in most vocational programs with 2 lesson hours a week. The content was basic hardware and software, using text editor, data base and spreadsheets for calculations. Hands-on experience was emphasized with less lectures and more counselling from the teacher.

More advanced courses were established (2nd year) and the industrial classes started to use the first CNC-machines and CAD-systems. Advanced classes in electronics, automation and process control were also started. At the time 2-year combined courses were promoted and became popular. In these programs combine vocational subjects and general subjects, and graduate with a general diploma. The first course on computer science, combining hardware and software were started in 1984. For software development Pascal was used, later changed to C++, Java and other software tools.

Content and teaching methods

Teachers were active on curriculum development, writing text books, continuing education of teachers, and school reform work on national level. The department of electric and electronics were involved in a restructuring of the many basic courses into a broader basic program. This became the model of the new reform of upper secondary education in 1994, often referred to as Reform 94. Consequently, a broad range of industrial programs were merged into one program (*Table 5.4*).

Around 1990 Windows was and the first email system was introduced in some classes, but still on stationary computers not connected in a network. The Internet breakthroughs first occurred in 1995 and the Hugin network connecting 13 primary and schools in Kongsberg and Notodden was establishes as a project by Telemark University College and Kongsberg Vocational Technical College at Tinius Olsen School. The project received some grants from the government and submitted their

report three years later 1998 (Aakre, 1998). Some school like Tinus Olsens School also installed the first local networks (LAN). Exams and student works could be submitted online and not by disk.

Table 5.4. Example Type 1 programs in Kongsberg. From Electric Program to Vocational College (2019)

Program (NQF Level 4)		Program (NQF Level 5)	
Basic (1 year)	Advanced (2-3 years)	<i>Vocational College (2 Years)</i>	
<i>Electro</i>	<i>Automation (4)</i>	<i>Electro</i>	<i>Mathematics and Physics</i>
	<i>Electro (10 incl. Maritime)</i>		<i>Communication (Languages)</i>
	<i>Data and Electronics (4)</i>		<i>Leadership</i>
	<i>Avionics (4)</i>		<i>El-systems +lab</i>
	<i>Cold and heat pump technology.</i>		<i>Web-programming +lab</i>
<i>12 other basic programs</i>		<i>Example: Industrial digitalization</i>	<i>Industrial intelligence + lab</i>
			<i>Agile production + lab</i>
			<i>Project</i>
	<i>Transfer to general program</i>	<i>College or university (Level 6-8)</i>	

<https://www.udir.no/k106/EL>. <https://fagskolen-tinius.no/Utdanningstilbud2/Elektro>

.Digitalization of teaching and learning developed rapidly as the capacity and speed of computers and networks improved. National networks were established, exams carried out online and students were able report their surveys to the government online. National and international test like PISA are now online, not on paper.

The first online classes for teachers in Kongsberg were held from Telemark University College in 1992, using email, and the first online class of teacher education in 2009. Gradually online courses were held on vocational and technical education in Kongsberg as well.

Today, projects and problem based learning are frequently used in most programs and subjects. Assessment is more often based on products, papers and portfolios made by the students who receive counselling along with individual or group work. The concept counselling for learning is now widely accepted and used by teachers of vocational education (Aakre, 2013; Harlen, 2007).

This text was written during the Covid19 epidemic in March 2020 when schools were closed. Now teachers teach from their homes and the student follows the teaching from home. However, it is also a reminder of social differences due to social and technological changes. It is estimated that 10-20% of the students can't benefit from these classes because they have no tablet or lap-top.

5.2 Kongsberg and Type 2 Programs (1980-2020)

At the end of the period there were three type 2 programs available in Kongsberg: Design and crafts, Sports and Music dance and drama. In addition Art, design and architecture as elective subjects within the general program (*Type 3*).

In 1994 a broad range of programs from old traditional crafts to modern fine arts were merged into one program on Arts and Design, with drawing, form and color as the basic skills. At first, the former 1-year Tailoring (*søm*) at Tinius Olsen School was closed down, but was later reestablished as an advanced course on Design and Textile in a 3-year program. Most of these course had one problem in common: for a long time there had been few or any apprentice contracts (Aakre, 2005; 2015). Therefore, the second and third year the students could chose to as a general diploma instead of a journeyman certificate. In the following year there was a lot of discussion on this mixed program, many changes were made and still there seems to be discussions. Many felt happy with the program as they could continuers their studies in a college or university, for instance teacher education. However, those who wanted to learn a specific craft felt disappointed by spending most of the time learning arts, drawing, form and color. Hairdresser wanted to cut her not to make drawings, the textile designers wanted to make clothes and the boat-builders wanted to design and learn the olds craft for making boats.

Tabell 6.3. Example Type 2 Program in Kongsberg. From Design and Crafts to Meister from Vocational College (2019)

Program (NQF Level 4)		Program (NQF Level 5)	
Basic (1 year)	Advanced (2 years)	<i>Meister Vocational College (2 Years)</i>	
<i>Design and crafts</i>	<i>Design and textile (11)</i>	<i>Fashion Design</i> <i>Example from School of Fashion Industry, Oslo</i>	<i>Design & Construction</i>
	<i>Design and woodwork (5)</i>		<i>Portfolio and Mini-collection</i>
	<i>Occupational therapist</i>		<i>Entrepreneurship etc.</i>
	<i>Boatbuilding (2)</i>		<i>Study tour to London</i>
	<i>Gunsmith</i>		<i>Networking</i>
	<i>Duodji (5) (Same Crafts)</i>		
	<i>Design (Ceramics)</i>		
	<i>Hairdresser</i>		
	<i>Interior design (3)</i>		
	<i>Design and Jeweler (3)</i>		
	<i>Blacksmith</i>		
	<i>Watch and instrument maker (4)</i>		
<i>Piano tuner and technique</i>			
	<i>Transfer to general program</i>	<i>College or university (Level 6-8)</i>	
<i>Arts, Design and Architecture (General program)</i>		<i>College or University (Level 6-8)</i>	

<https://www.udir.no/kl06/DH>. <https://www.sofi.no/home/>

One major change was made by creating Arts, Design and Architecture as elective subjects within general program, and Design and Crafts as a vocational program. The structure of Design Crafts after

the reform of 2006 is outlined in table 6.3. The former textile program at Tinius Olsen School, can be rediscovered as Design and Textile as an advanced course. Now there are vocational colleges available for these students, like Fashion Design at School of Fashion Industry in Oslo, which is a private college. In private schools the students have to pay tuition, about 100.000 NKr. per year.

5.3. Other type schools and programs 1980-2020

By 1980 most upper secondary schools were integrated in the same system and regulated by the same law. The present law of 1998 even covers both primary and secondary education, as well as adult education and apprentice training in a workshop or business.

In this period more and more private vocational schools were established, but they have to operate within the frame of national law and curriculum.

The folk high schools are even more popular than before because of their philosophy of no testing and no formal examination. One reason seems to be the rigid testing regime implemented the last 20 years (Brubæk, 2019). Its law of 1948 was replaced by a new law in 2002 (LOV-2002-12-06-72).

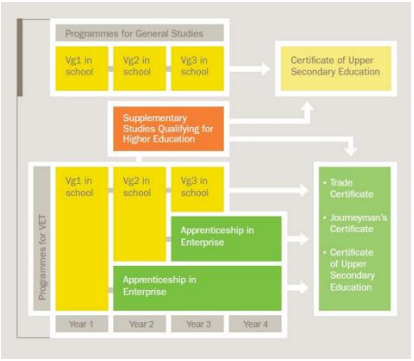
7. Renewal 2020, what is new?

The curriculum reform LK20 (Udir, 2020) is not called a reform, but a Renewal and there are no major structural changes compare to the former reforms analyzed in this study. The law of education is maintained and not renewed, and the tracks for vocational and technical from the 1990's is maintained (Table 6.1, left), but the number of type 1 vocational programs has been expanded from 10 to 13 (Table 6.1, right). However, sustainable development (SDE) is emphasized in all subjects as well as in the vocational programs.

From the second academic year (vg2) three of the vocational programs are adapt to a third year (vg3) in the general program in school instead of 2 years apprentice training in a company. In these three programs, it has been difficult for many years to gain apprenticeship contract, a problem that has existed for long (Aakre, 2005, p.). We are back to the ideas of the 1970's with combined programs.

- Crafts, design and product development
- Information technology and media production
- Sales, service and tourism

Tabell 7.1 Type 1 Programs in Norway from 2020

Tracks	VET Programs 2020-
	<ul style="list-style-type: none"> • <i>Building and Construction</i> • <i>Electricity</i> • <i>Health and youth development</i> • <i>Agriculture, fishing</i> • <i>Restaurant and food subjects</i> • <i>Technical and Industrial Production</i> • <i>Hairdresser, flowers, interior and exposure design</i> • <i>Crafts, design and product development (1)</i> • <i>Information technology and media production (1)</i> • <i>Sales, service and tourism (1)</i>

Hairdresser were unsatisfied since they were affiliated with the program Arts and Design in 1994. Especially because many of the students did not like to learn general theory, but to learn the skills of cutting hair as early as possible. Some private schools established such schools. After years of discussions hairdressing was moved to a new program Design and Crafts, but still not satisfied. From 2020 they were transferred for the third time to a new program called “Hairdresser, flowers, interior and exposure design”. Hopefully, this will be a solution to a long discussed problem. But still, hairdressing, florist and interior design are quite different.

The other renewals are general and apply to the entire education from first grade in primary school to last year in upper secondary education (K1-13). Most of them verbal and expressed as guidance to school owners and teacher. Competence is defined as the *ability to acquire* and apply knowledge and skills to master challenges and solving tasks in *known and unknown* contexts and situations. Competence also involves understanding and ability for *reflection and critical thinking*.

The content of curriculum is differentiated between core elements and three interdisciplinary themes. Core elements are explained as the most important academic content the students will work with, what students must learn in order to master and apply the subject, and consists of central concepts, methods, ways of thinking, areas of knowledge and forms of expression. However, how this apply to vocational programs seems not very clear.

Interdisciplinary themes apply to all levels (K1-K13), all programs and subjects including vocational programs. They are:

- Democracy and citizenship
- Sustainable development (SDE)
- Public health and life management

VET is also general education

On learning strategies, depth learning is emphasized, not only memorizing and factual learning. Depth learning is explained as gradually development of knowledge and lasting understanding of concepts, methods and connections in disciplines and between disciplines. It also means ability to reflect on own learning and use what we have learned in different ways in known and unknown situations, alone or with others.

These ideas are not really new in the discourse in education in Norway. They were implemented in teacher education in the late 1990's and rooted in, among other things, German didactics (Klafki, 1991 and 2013). But the PISA studies shifted their focus towards detailed goal management of teaching and learning that made the basis of the school reform "Kunnskapsløftet" in 2006.

The new trend is uplifting and can be understood as a reaction to the goal management in recent years. However, the assessment and examination systems are critical in whether these good intentions will succeed. A special group was supposed to present a report on examination by end of March 2020, but not yet available. However, the mandate for the group leaves not many options but to maintain most of the testing system as it is.

The image of Norway abroad is high degree of gender equality and that most women in Norway work, even short after having children. Gender have also been a top priority in most reports on education in for decades. However, but in the latest reports the topic of gender is almost absent, though it says that "It is a prerequisite that the education should still be arranged for everyone independently by gender, place of residence, background and level of function".

Table 7.2. Gender differences in 3 Vocational programs in Norway 2019 (Statistics Norway)

Program	Men		Women	
<i>Technology and Industrial Production</i>	9932	91,2 %	1271	8,8 %
<i>Design and Crafts</i>	885	24,5 %	2725	75,5 %
<i>Health and Child Care</i>	4691	19,9 %	18828	80,1 %

May be the gender problem in Norway is solved once and for all? Recent statistics show that there are still large gender differences in the various educational programs (Table 6.2). Traditional industrial programs are dominated by men, around 90%. Health and Child care are still dominated by women, about 80%. In other “soft” programs like Design and Crafts also still dominated by women, about 75%.

7.1 They way forward: NOU 2019:2 and NOU 2019:25

To prepare for the future two national investigation committees were appointed in 2017. The first report on future competence was published in February 2019 and the report on secondary education in December 2019 (NOU 2019:2 and NOU 2019:25). Unfortunately, one scenario is missing in both reports: The Norwegian oil economy is soon coming to an end. Many new jobs must be created in the coming years, especially within the “green” economy and “green” technology

The first report present three scenarios and all three scenarios indicates that employees of the future will have on average higher education level than today, and that the number of employees with only secondary education will fall (NOU 2019:2, p. 132). However, the scenarios also indicate that need for vocational education may increase. Due to demographic trends will the proportion of education in health care will increase. The level of education seems uncertain. The future need for vocational and technical education on college level (Level 5) may increase.

The second report on upper secondary education seems less coordinated with the first report, and the future labor market is not discussed. The overall mandate of the committee was to consider:

“Whether upper secondary education has a structure and content that facilitates most possibly complete upper secondary education, and whether today's model for higher education meets the needs of the working life and society for competence”. (NOU 2019:25, p.14).

The committee suggest that the present dual system of general and vocational education is continued, and based on documented competence to advance in the system. Adapted education is stressed in the sense that some students may need longer time and may need special support to succeed. So far no big

changes from the existing practice. However, an adults' right to higher education is expanded to include adults who need qualification to participate in working life.

Unfortunately, the problem of few available apprentice contracts is not discussed, in spite of the fact that dropout and low completion rates from vocational programs were part of the mandate. A legal right to apprentice training, in a company or in school, for all students who choose to take a vocational program would have been a significant improvement. Today the system is a “trap” to dropout and a life out of work.

6.2 Status of economy and future jobs and skills

What do the report say about future jobs and skills? Almost nothing! Changes in working and social life will affect the need to learn all of life (p. 23)

Det er vanskelig å komme unna en konklusjon om at videregående opplæring er et relativt utforsket område. Relevant forskning av høy kvalitet er viktig på alle nivåer. Det er viktig for utformingen av de nasjonale retningslinjene. Det er viktig på regionalt nivå, skolenivå og i opplæringen (s150)

Table 7.2. Export and major employments in Norway 2019 (Statistics Norway)

Product	Export (1)		Import (1)	
<i>Oil, gas and metals</i>	424.144	46,1	23.520	3,1
<i>Industrial products</i>	400.777	44,3	699.778	92,6
<i>Fish and food products</i>	66.030	7,3	18.773	2,3
<i>Other</i>	20.789	2,3	15.111	2,0
<i>Sum</i>	903.904		755.593	
<i>Profit</i>	148.211			

Notes 1: In Billion Nkr and Percent

8. Discussion and conclusion

This study on vocational and technical education in Norway has been a long journey, categorised in four time periods. Norway has changed from a privileged society through liberalization and today's

democracy with a mixed economy, welfare state and free education for all. The present system of free education include a variety of vocational and technical education on upper secondary (NQF Level 4) and post secondary level and vocational colleges (NQF Level 5) (Table 3.2). Behind this transformation there are different political ideologies and philosophies of education and a big leap in technological development.

Vocational and technical education were categorized in two types, *Type 1* and *Type 2*. They were studied and analyzed over four time periods, beginning with traditional crafts preserved in old viking ships. Such crafts were mentioned in the first national Law of Norway (Lov, 1267). They represent experience based knowledge that represent a bridge to present time. The last picture is from the latest innovation in Norwegian ship building: autonomous ships controlled by remote control, and powered by green technology like the viking ships powered by the wind (Figur 6.1). They represent science based knowledge and examples of the new technologies that need to be thought in our vocational education today, and prepared for in recent school reforms (Udir, 2020)



Figure 8.1. Autonomous ships powered by green technology (Photo: Kongsberg Maritime)

Before 1875 very few and mostly privileged Norwegians had access to education beyond primary education, and women had even less alternatives. However, liberalisation and industrialisation from about 1850 led to a growing need for skills and expertise in new fields of technology and science. Vocational and technical schools were established, but in most cases left to private initiatives supported by grants from the government. This liberalist ideology continued to dominate vocational and technical education in Norway into the 1930s. The economic depression of the 1930s paved the way for a more collective and social democratic ideology. Extensive reform work was initiated, and the first law on vocational education was passed in 1940. Unfortunately, world-war II broke out, Norway was occupied by Nazi Germany and the new law was not put into practice until 1945.

Between 1945 and 1980, driven by a collective ideology, Norwegian education expanded more than in any other period, and vocational education was a high priority. The basic structure of today's upper secondary education was put in place by the law of 1974. However, the idea of two separate systems, one technical and one academic, was abandoned during the same period. The influence from the American high school system was also strong. Among other things, combined courses with both technical and academic subjects were implemented and became popular. However, the students still had no formal right to 3 years of continuous education. Many took several basic courses.

The first years of the period from 1980-2020 were characterized by experimental activities. The problem of many students who had to take several basic courses instead of advanced courses became obvious. The industry was also dissatisfied because many apprentices lacked specialized knowledge. Therefore a comprehensive reform process in the 1990's introduced a legal right to 3-year education leading to either a crafts- or journeyman certificate (*Type 1*), a general diploma (*Type 3*) for further studies or documented sub-competence. For vocational education the 2+2 model was introduced, with 2 years of combined theoretical and practical training in school, and 2 years of specialized apprentice training in a company. The apprentice system is basically private, but funded by the government. Unfortunately, and in spite of many promotions, by 2020 only about 60 % of the candidates are able to get an apprentice contract. The apprenticeship system is also sensitive to business cycles.

In addition to the *Type 1* vocational and technical programs, a *Type 2* program was identified that does not fit in to the "classical" *Type 1* programs leading to a crafts or journeyman certificate. They first existed as informal education in the household and represent national tradition that is old and unique for Norway. They also have elements of arts and aesthetic values. In the early industrial era schools and programs for such arts and crafts were established as a reaction to the industrial "inhuman" method", and to preserve and promote local industries instead of buying cheap and pure products from abroad. The first schools for women were in the forefront of this national romantic movement. Gradually they were influenced by progressive and aesthetic educational philosophy. Their philosophy is closer to that of John Dewey and the American high school system than the German "Arbeitschule" founded by Georg Kerscheiner. Today they are a variety of programs on arts, crafts and design leading to a general diploma instead of a crafts or journeyman certificate. They also reflect the fact that today there are vocations never thought of as vocations a few decades ago, in sports, arts, music drama. Most professionals in these fields attend a gymnasium of sports or an upper secondary program in arts, design, music or drama.

Finally, there is also a paradox: this text was finished during the Covid19 lock down, and all schools in Norway closed. Teachers and students had to stay stay home, but online classes were continued every day as scheduled by the help of digital and communication technology, and social media. However, it

is also a reminder of social differences. It is estimated that 10-20% of the students can't benefit from these classes because they have no tablet or lap-top.

Educational for work

The relation between work and education was one of the research questions at the beginning. Since the first available statistics, the employment and types of work in Norway has changed dramatically (Figure 6.2a). Today most people are employed in the service sector and there are jobs never thought of some decades ago. This is also reflected in the variety programs of secondary education. Vocational programs related to some sort of aesthetics are more and more popular, especially among girls, like arts, fashion, music, drama, film etc. Boys and girls work hard and study for a professional career in sports. They are not hobbies anymore, but well paid jobs with glamour. Tourism is another type of work that is now important in Norway and many other countries, and there are special programs for this in school, but combined with skills in foreign languages and cultural understanding. The lock down during the Covid19 also reminded us about the importance of tourism in modern business and employment.

The traditional jobs in technology and industry has changed but still most important in foreign trade. Climate change, new forms of energy and recycling of materials has changes the content of vocational and technical education for this type of jobs, and new skills need to be developed. In the case of Kongsberg there are new trends in education on alternative energy and composite materials for better strength and low energy.

From the earliest statistics, 98% of the population had their work in primary industries in 1875. In 2020 only about 2%. The reality is turned upside down. The typical industrial society had its golden age from about 1945-1975 when many traditional industries were closed down in Norway. But still people need food and equipment for producing food, transportation and to keep food quality.

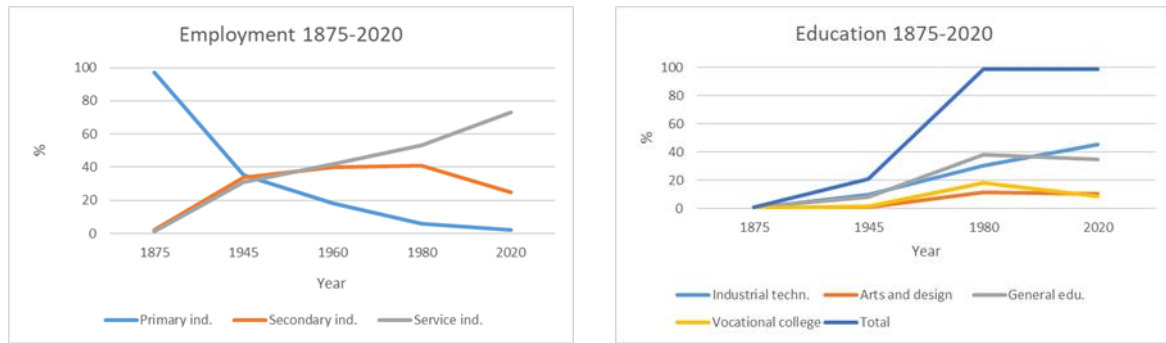


Figure 8.2. Employment vs. education in Norway 1875-2020. Graphs compiled from national statistics.

Philosophy of purpose and management

Management: Centralized control, local responsibility ... split authority and responsibility

The political systems in Norway and its view and priority on vocational and technical education has changed over time. The most obvious change is the fact that attendance 100% since 1980.

Since 1945 it had very high priority under different governments and ideologies. Before ww2 Norway was still a class society. When the Labor party came to power in 1935, the idea was to build a complete system of vocational and technical education from first year of apprentice to technical university as parallel and an alternative to the academic path. There were also huge gender differences. There were few alternatives for girls, and the schools for girls were primarily preparation for family life.

The war brought the classes closer together and gradually an integrated system were developed on the bases of free education for all. Until now governments from different political parties have supported this idea. Today more girls than boys take education, they earn better marks and more girl than boys transfer to higher education. However, there are still gender differences on what education boys and girls prefer to take. Vocational and technical education is still quite traditional with majority of boys in the “hard programs” like constructions, mechanics, construction, etc., and majority of girls in “soft programs” like health service, education, arts and design.

Gender, ethnic social equality

Today about 98 % of all boys and girls in Norway attend a program in upper secondary education. In 1945 percentage was only 20 %, so there has been a great improvement. From this point of view there is equality of gender in attendance.

However, this is not the full truth: the completion rate is lower, only about only 70 % and even lower from vocational education. One reason seems to be the fact that vocational education is based on a private system subsidized by the government. Only about 60% of the students in vocational programs are able to have an apprentice contract after 2 compulsory years in school.

Within the different vocational programs there are still big gender differences. Only minor changes had taken place during the last fifty years. Boys and girls in vocational education still seem to choose vocation according to their gender, and not very different from their mothers and fathers.

The first vocational school for the same people on doudji, their own traditional arts and crafts, was established in 1952 and improved in the 1970's. Today Doudji is a 3-year *Type I* program leading to a Journeyman Certificate in doudji. There is also a similar program on reindeer farming, both with special focus in Sami culture and language. However, the percentage of same attending and completing upper secondary education is still lower that the national average.

Other social or ethnic minorities are integrated in the ordinary programs.

Content and methods of teaching and learning

The length of basic vocational and technical education in Norway has not changed much since such education were introduced, but today the relative amount of theory is higher. Primary education has also increased from 7 - 10 years. When the system of technical evening schools were introduced in the 1970, the time to earn a certificate of apprenticeship was 3 years, today 3-4 years. But today there are also a lot easier to transfer to a vocational college or university, and many do.

Another major change is that basic vocational and technical education has become more general in broader programs. In 1994 more than 100 basic courses were reduced to 9, in 2020 adjusted to 13.

The apprentice system is maintained and expanded to many more subjects. Originally, home economics, health care and skilled work in education (not teachers) are included in the same apprentice system. However, it is a private system funded by the government. There is no legal right

or guarantee to have an apprentice contract. Only about 60% do, and this is major problem causing many students to drop out from school without a diploma or certificate of apprenticeship.

The methods of teaching and learning are far more democratic than before. Now there are less lectures and memorizing, less demonstrations and more hands on experience. This process started in the 1950's and by 1970 more progressive and student centered methods were introduced. Problem based learning, projects and autonomy in the learning process were implemented. In the 1990's such learning methods were more and more supported by information and communication technology. Feedback to the schools and some exams are also online. Today many courses in vocational colleges are provided online and off campus.

Assessment and Examination

The idea of Assessment for learning was introduced in the Norwegian schools from about 2010. Teachers were also trained for this strategy. There are no research on the effect of this strategy but teacher report they practice this strategy.

Some traditional tests and exams are still maintained as before, especially in theoretical subject. But even such tests now tend to be more open and more related to practice than before. In most vocational and technical programs projects and portfolio are more often used for assessment. Projects and partnerships with companies are also stressed.

One unique method of assessment has been maintained in Norway: The apprentice exam and the journeyman piece. Most of these exams are now held in the company where the students has contract, not in the school. In that way tests are on real time operating systems.

Gender

Recent statistics show that there are still large gender differences, especially in vocational programs. Traditional industrial programs are still dominated by men, around 90%. Health and Child care are still dominated by women, about 80%. In other "soft" programs like Design and Crafts also still dominated by women, about 75%.

Sustainable development and the future

In a few years the oil-economy in Norway will come to end and many new *green* jobs need to be created. Against this background, it is a paradox that this challenge is not addressed in the latest report on future upper secondary and vocational education in Norway. However, emphasis on sustainable development is probably the most important innovation in the new curriculum LK20 (Udir, 2020). This topic is compulsory both as an overall theme, in all school subjects as well as in all the vocational programs. Practical steps need to be taken on personal matters like consumption and handling of waste, recycling, awareness of materials harmful to humans and the environment as well as how to create a zero-emission society locally and on a global scale. However, there is left to see how this will be operationalized in practice.

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