

## **Rjukan Apprentice School** A pioneer in Norwegian vocational education?

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*Rjukan apprentice school, named “fagskole”, was established in 1921 as a 2-year preparatory school for crafts and industry. The school was adapted to a 3-year program with a 3rd year as an apprenticeship in a company before they could take the professional exam. It was the first school in Norway to adopt this model, which was introduced as the national system for vocational education and training in 1994. On 15<sup>th</sup> of May 2023, it was 100 years since the first pupils at the school took their exams. The school is also unique in that Rjukan is now a world heritage site on UNESCO's list since 2016.*

*The purpose of this article is to analyze and discuss the social conditions and processes that led to the establishment of the school and the years that followed. Activity theory was used as a theoretical and methodological frame of reference, and it is based on historical sources from the school's archives, newspapers, and books. These are interpreted and analyzed in the light of other research and literature on the development of Norwegian vocational training as it appears today.*

*The establishment of Rjukan apprentice school must be understood in the light of the special conditions that characterized the society at Rjukan: rapid industrialization, urbanization, technological progress, and major fluctuations in the global economy. In addition, the school's first year mirrors a national project to establish comprehensive vocational education and training from basic education to higher education.*

*The course for electricians was the most innovative for its time by emphasizing theory in combination with work on authentic installations. It is explained by the large-scale development of hydroelectric energy for industrial purposes, on which the company Hydro was founded. At the time, Vemork*

*power station was the world's largest. The energy was used to split nitrogen (N), hydrogen (H<sub>2</sub>) and heavy water (D<sub>2</sub>O) from air, and also to make ammonia (NH<sub>3</sub>). The main product at the time was fertilizer. Today, the hope is that hydrogen and ammonia can be used in the fight against global warming.*

*The course for mechanics was also more modern and lasted longer than corresponding programs at the time. They introduced carefully planned models that can be traced to the Czech Republic and Germany. The course for carpenters used a system inspired by the Swedish school sloyd, but at an advanced level. Instead of models, they put more emphasis on making authentic wooden products.*

*Today, Rjukan apprentice school reminds us of the importance of the industry's commitment and good access to apprenticeship contracts. In a broader perspective, knowledge about the school can serve as inspiration in today's debate about the need for more professional practice in our schools.*

### **1. Introduction and perspectives**

"They came to the Vestfjordalen valley" writes professor, Helge Dahl, himself born and raised in Rjukan (Dahl, 1987, p.71). At the turn of the century, there were only 369 people living in the parish, and not many more in the summer of 1907 when the large influx took place to build Hydro's and Norway's largest industrial project to date. A completely new city with infrastructure, housings and industrial buildings was erected in a short time. To supply the new industry with electric energy, the largest hydroelectric power plant was built at Vemork, near the Rjukan waterfall a little further west in the valley. Everything raised by the company in a modern and industrial style. The architecture reflects a sharp class division between management, white-collar workers and

blue-collar workers. But the standard was high for its time and the workers' housing was spacious, had electricity, water and a bathroom.

Three years later the population was 2,679, and in 1911 they named the town Rjukan. In 1914,

the town itself had more than 4,000 inhabitants. In 1920 there were a total of 11,460, of which 8,700 in the center of the city between the narrow mountains where the day of the sun is still celebrated on 21<sup>st</sup> March every year.



Figure 1. Rjukan seen from the Krosso cable car (a). Old Vemork Power Station where also heavy water (D2O) was produced for use in nuclear reactors (b).

The workers came from all corners of Norway and Nordic countries. Many were Swedish “Rallare” with their past and experiences from Malmberget in Kiruna and the construction of Ofoten railway to Narvik. Some claimed they had met with “Svarta Bjørn” and even got a dance close to her fair bosom. This was hardly true, but warm to juggle about between whipping blows and volleys on days with cold snowdrifts. “Do your duty and claim your right” they wrote on their banners. Professional pride and honesty were high, and no one was to take away either the sickness fund or the strike fund without good reason. With the new 8-hour day, which they had fought for, and with their own money they built their cultural center in modern architecture and named it the World Theatre. The library became the largest collection of socialist literature in the Nordic countries. The entire city was raised and ruled by the company Hydro in a strict 3-class system. The World Theatre, its history and architecture, is now an important element in its status as a world heritage site on UNESCO's list.

#### *Apprentice school vs. “Fagskole”*

In a few years, Rjukan became a melting pot of people with different experiences, languages, and dialects, with the many tensions this entailed.

Perhaps it can be described as a social experiment that Norway had not experienced before. The many young families had children who grew into large cohorts of children who were to have school, skilled training, and work. A middle school and gymnasium were built, but a school for practical education was missing. A technical evening school was established, but it was held in the evening and only provided theory for those who already had an apprentice contract with a company. Apprenticeships were difficult to get, then as in our time. In the new profession for electricians, regulations and safety also had to be considered before young people could be allowed to work independently. The need was therefore a new type of school that could give students both theory and practical skills before entering work, and preferably with an emphasis on learning through practice and work.

For this purpose, a 2-year day-school for apprentice boys was chosen. However, Norway did not have such a school at the time. The typical school for this purpose was technical evening schools that provided only theory along with work at daytime. In addition, there was various shorter courses, from ½ to 1 year, at schools often named “fagskole”. Rjukan fagskole was therefore chosen as the name of the school.

However, based on today's terminology, and translated into English, Rjukan apprentice school is more correct. Finally, what pedagogical ideas was typical for this school?

Learning through work can be explained as an art through actions and reflection in interaction with the power of thought. This is roughly how it was described in our oldest textbook on didactics and pedagogy, *Didactica Magna*. Comenius equated practical subjects such as arts and crafts with theoretical subjects (Comenius, 1658, p.148). Something similar is expressed in the descriptions of sloyd as a pedagogical system: "You learn to recognize through work" (Thane, 1914). Here, however, the author will add that an element of reflection on practice must be added (Aakre, 2005, p. 27).

Comenius is also relevant in relation to the practice models and exercise series that later came into use in Norwegian vocational training. First at Skiensfjorden technical school in Telemark from around 1890, and later at Rjukan apprentice school. These came into use after a study trip to Komotau in Bohemia (Dick, 1889). *Didactica Magna* was also written in Bohemia before Comenius had to go into exile. Many of his followers fled on to America where they received amnesty among Quakers in Pennsylvania. A statue of him still stands there outside Moravian University (2023). The Bohemian "Moravians", as they are referred to, realized Comenius' great idea of schooling for all in the form of a broad and comprehensive program with arts and crafts as a central subject in 1742. School was compulsory for both girls and boys, and independent of faith, race and ethnicity. One of the girls from the first cohort was 16 years old when she walked to Salem in North Carolina to become a teacher at a similar school there, which later became Salem College (2023) for women, today ranked among the best in the United States. Both educational institutions are known for their teacher training.

At Rjukan apprentice school there were no girls, only boys. It was still common in Norway for educations after primary school. The practice range on the carpentry course included, among other things, a tool cabinet, and the apprentice's own piece a separate planing bench (RA, 1938).

They were of the "Gustaf Larsson" type known from Otto Salomon's teachers' school in Sloid from 1874 (Salomon, 1902). This school was located in Näs outside Gothenburg, and laid the foundation for the educational system in many countries. Another pioneer in this movement was Konrad Kjennerud from Kongsberg in Buskerud. Gothenburg was one of the places engineer Bjarne Nilssen, head of the committee for the establishment of the vocational school, and secretary teacher Lars Larsen visited on his study tour in 1919 during the planning of the Rjukan vocational school.

Rjukan apprentice school started its first school year by admitting 46 students from 53 applicants on 14 September 1921. The students were divided into three courses: mechanic, electrician and carpenter in what was called the "Centralbrakka" at Rjukan Salpeterfabrikk's factory area (RA, 1921). The principal of the school was Martin Sellæg, a local engineer. Rjukan Salpeterfabrikk became an important arena for the practical training, especially in the course for electricians who relied more on authentic work than school training. In 1946, the school formally changed its name to Rjukan vocational school in accordance with a new law that had been adopted just before the outbreak of the Second World War in 1940, but postponed until 1946 (Lov, 1940). In 1953, all vocational training for both boys and girls was brought together in a new and modern school building. Later it was expanded with both vocational and general subjects to what is today Rjukan upper secondary school (Rjukan videregående skole, 2023).

From before, Rjukan had a Technical evening school which was established in 1916. It was gradually integrated with the vocational school. Rjukan Vocational School therefore represents a link between old and new times in Norwegian vocational training. The purpose of this article is to illuminate and discuss the social conditions and processes that led to the establishment of the school and the years that followed. Activity theory was used as a theoretical and methodological frame of reference, and it is based on historical sources from the school's archives, newspapers and books. These are interpreted and analyzed in the light of other research and literature on the

development of Norwegian vocational training as it appears today.

### *Activity Theory and Vocational Education*

Vocational subjects differ from pure scientific subjects in that practice forms an inseparable part of the subject and learning a vocational subject. Activity theory was therefore chosen as the analytical tool in the work with Rjukan Vocational School. By focusing activity theory on practice, one gets past the need to distinguish between applied and pure science. It also makes it possible to see theory and practice in context where practice is included as an essential and often compulsory part of the training itself.

The origins of activity theory can be traced to several sources. But in working on this article, one chose to build on the Scandinavian tradition that Yrjö Engeström has made an important contribution to developing (Engeström, 1987,

p.78). This has been adapted to the purpose by the author and visualized in Figure 1.

Activity theory can be explained as a meta-theory for describing and analyzing actions in a socio-technical system through six related categories. In this context, based on Figure 1, they can be explained as follows:

Actors and objects, and relationships between these, are central categories. In the school system, students, teachers and others in the professional environment are actors, while mediating tools are objects in the learning work. The learning result from these processes is passing the subject exam, as well as exercises done in laboratories and school workshops. The school is also governed by rules in the form of timetables, curricula, rules of order and examinations. In a wider context, the school interacts with societal and historical conditions locally and nationally.

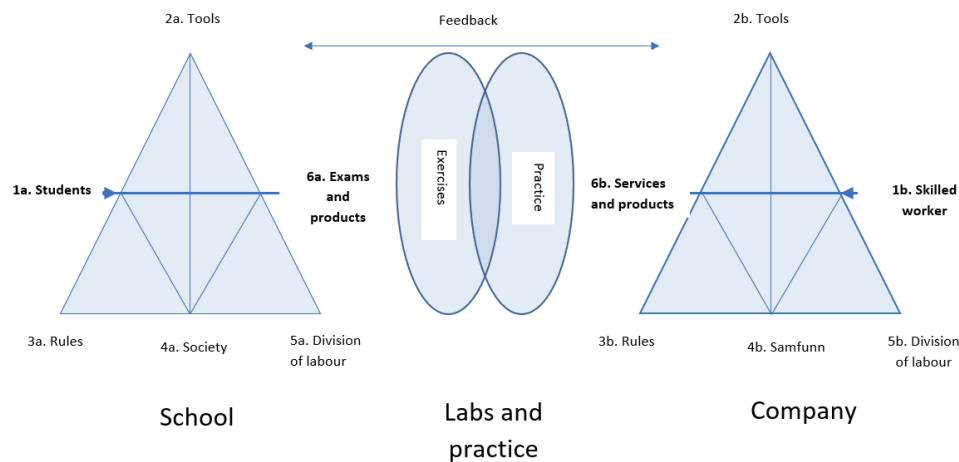


Figure 1. Activity Theory and Vocational Education (Aakre)

When transitioning to practice and an apprenticeship in a company, students become apprentices or apprentice candidates where the aim of the training is to become skilled tradesmen who can provide independent work in the form of services and/or products. Along the way, they can also provide limited value creation. Companies are subject to other laws and regulations than schools, while the social and historical context can be quite similar.

## **2. Vocational training in a time of crisis**

The establishment of Rjukan apprentice school can be understood in the light of the vocational training of the time and the special conditions described above about the society in Rjukan (Aakre, 2021 and Dahl, 1983). It was characterized by rapid industrialization, urbanization, and a demography with a predominance of young families with children.



The labor market was dominated by Hydro, an export company operating in an international market that was changing rapidly. New technology actualized the rationalization and relocation of parts of the business to Porsgrunn. In sum, this made it difficult for the large youth cohorts to find work at an age where they were too young to move and look for work outside Rjukan. The arguments were therefore to combine employment with practical education in the most critical years. The idea of learning through work, which still characterizes the political discourse on vocational education, stood strong. Emphasis was also placed on avoiding unemployment among young people with the negative consequences it was believed to have for society and especially young people in the short and long term.

Vocational training in Norway was still weakly developed at this time. It was largely left to local or private initiative and financing (Aakre, 2021). Workers in the new industry rarely received any other education than 7-year primary school. Those who were to take a vocational or journeyman's certificate had to acquire an apprenticeship on their own and receive the necessary practical training in a company. In parallel with this, they had to take theory in the evening in one of the technical evening schools that had been established after the government decided to grant subsidies to such schools in 1875- (Aakre, 2020). The standard time for this training was 3 years. But the main problem was that few managed to get an apprenticeship, especially in times of recession when the need was greatest. Many young people therefore found themselves idle during the day and without the theory they received in the technical evening school being of particular use to them. This was also the case with the technical evening school that had been established in Rjukan in 1914. This is still a well-known problem as many students today do not either get an apprenticeship contract with a company after 2 years at school (Aakre, 2019).

The need for a practical preparatory school for apprentice boys was probably first expressed as an anonymous input to Rjukan Arbeiderblad in 1913 (RA, 1913). After this debate had been going on for a few years, Tinn municipality decided to "appoint a committee for the

establishment of a technical vocational school at Rjukan" in a meeting on 24 March 1919. Engineer Bjarne Nilssen was elected as leader and teacher Lars Larsen as secretary. From there, the case developed rapidly, although at a critical point it considered closing down its work due to recession and poor finances in the municipality.

The committee took the conditions and the debate at Rjukan as a starting point and believed that the school had to be a 2-year school with training in a school workshop both years. They found out about similar schools and went on a study trip to Gothenburg, Oslo, and Trondheim. Trondheim Vocational School had been established the same year with a 1-year workshop school which the committee believed had many of the qualities they were looking for, but they insisted that the school should be 2-year, despite being advised against it.

The committee must have been very efficient. As early as May 1921, the Storting decided to support the school with 60% of the expenses (IKA, 2023). For comparison, it can be mentioned that Kongsberg did not start a 2-year vocational school until 1959, despite the fact that they received a large private fund for the same purpose in 1921 (IKA, 2022). The first thing they used funds from the fund for was to visit Rjukan, where they received curricula and lists for tools, instruments and machines.

In a short time, the committee managed to get the teaching committee for the technical schools to approve an experimental plan on the condition that it could not be done elsewhere. It was with this model that Rjukan vocational school paved the way for what is the main model in Norwegian vocational training with 2 years in school and 1-2 years in a company.

### 3. Organization and management

On 15<sup>th</sup> of September 1921, the newly appointed manager of Rjukan apprentice school, engineer and principal M. Seelæg, was able to welcome the first batch of 46 students to the new school: 16 students for the mechanical course, 18 students for the electrical course and 12 students for the carpenter course. The school year lasted 8 months from 15<sup>th</sup> of September to 15<sup>th</sup> of May with a total of 1116 hours of teaching

per year. The average age was barely 15 years. Three applicants had already finished upper secondary school and some applicants were over 20 years old. However, the youngest pupils were prioritized on the grounds that "the school is a school for young apprentice boys". The school was free of charge, and it had free school materials. However, the student had to pay a small NOK 5 when enrolling (IKA, 2023). School fees were justified by the fact that "completely free schooling is unfortunate from experience. A payment seems educational even if it is low" (School Board, 06.05.1920).

The Ministry of Church and Education was the governing body for the school, and it was given a local board of trustees of five members with Bjarne Nilssen as chairman. He had led the work to establish the school and led it with a sure hand together with manager Seelæg. The budget for the first school year was NOK 42,083. The school was municipal, but the state covered 60% with NOK 25,250 (Prop. S no. 47, 1921). The largest item of expenditure was salaries.

For premises, Hydro had provided "Centralbrakka", which had been newly updated for the purpose. It had a total area of just over 520 square meters on three floors and was equipped with modern machines and equipment for the three courses. The school also had its own forge. In addition, they could use some smaller barracks next door.

In the first years, the school was run according to a provisional plan. But on 19<sup>th</sup> of September 1923, a committee from the Ministry of Education came for their first inspection to discuss the school's curriculum and further operation. They were very satisfied with the school but raised some questions for discussion. They believed, among other things, that the number of hours was higher than for an apprentice school and that the school should be able to be shortened to 1 year. This question had been a topic in the past, but the superintendent and the board of trustees argued well that a 2-year model was the best. They justified their argument by claiming the suggested model helped keep the students at school every day. They also argued that the preferred model was easier to implement with regard to acquiring local and experienced teaching staff who had a

permanent job in the industry.

On the other hand, the committee argued that the total number of hours was low compared to a normal working week for workers. As a compromise, they agreed to increase the number of hours somewhat and that the students were given homework in, among other things, arithmetic exercises that could be counted towards the number of hours. It was also decided to introduce some teaching in Norwegian language in the first year by reducing some of the other subject. Furthermore, it was pointed out that the teaching material in science and materials science was too extensive in relation to the number of hours, and it was recommended that calculus should be taught together with the subject drawing for better concretization. In addition to this, the school was asked to draw up examination regulations. The Ministry of Education agreed to the revised curriculum and recommendations in a letter of 6<sup>th</sup> June 1924. This curriculum was followed unchanged until 1942 when the new Act on Vocational Schools for Craft and Industry was implemented as one of the first in Norway and in spite of the war (Lov, 1940).

#### 4. Content, forms of learning and assessment

The approved curriculum for Rjukan apprentice school consisted of three programs and nine subjects within each program. The curriculum differed from the other vocational schools at the time in that the time spent with practical exercises in the workshop was longer and that the theoretical teaching gradually corresponded to all three years in the technical evening schools at the time.

The theoretical teaching was laid out so that it linked directly to the practical work in the workshop. It was argued that it would be easier to form a coherent whole with support for both the theoretical and practical subjects. "The practical teaching seeks to give practice in the subject, the theoretical a better understanding". Subjects and hour distribution are shown in Table 1. In the column for percentage, the author has calculated a percentage distribution where the various subjects in drawing and calculation are combined to give an impression of the scope. In 1942, the number of hours was extended and adapted to the new Act

Table 1. Subjects and distribution of hours. The column on the right is after coordination with the Act of 1940

Subject	1 <sup>st</sup> . year	2 <sup>nd</sup> . year	Percent	After 1942
Practice in a workshop and electrical for the electricians	706	816	68%	
Freehand drawing	90		15%	
Construction drawing	20			
Projection drawing	80			
Professional drawing	40	120		
Practical calculation	90	30	12%	152
Measurement strategy	60	30		
Subject calculus	30	30		
Science and materials science		90	5%	114
<b>A total of 31 weeks of 36 hours</b>	<b>1116</b>	<b>1116</b>	<b>100%</b>	
<i>Vocational economics</i>				76
<i>Norwegian language</i>				114
<i>Foreign language or social studies</i>				76
<i>Physical education</i>				76

on vocational schools for crafts and industry (Lov, 1940).

The curriculum emphasized that the teaching should start by providing the "best possible basis for the practical implementation of the subject" the individual had chosen. There should be good progression in that dexterity, accuracy, conscientious marking and that the students should learn to comply with the individual task's requirements for measurement in the first year". This was well received by the education committee that came to inspect in the autumn of 1922. In the follow-up letter from the ministry dated 23 March 1923, there were only minor adjustments to be made in the final plan (KUD, 1923):

- Technical calculation should go the same with the corresponding technical drawing
- It was recommended to give some more teaching in Norwegian
- The curriculum in science and material science seemed extensive
- Furthermore, the ministry recommended that the pupils were given suitable arithmetic tasks in the time between the first and second year of school so that they stay active in their schoolwork

The center of the teaching and learning was a large number of practice models, or pieces

of work, for each of the three disciplines. The training course in the course for mechanics had a total of 24 works in the first year and 28 works in the second year, a total of 42. Some of these are shown in Figure 1, and, as mentioned before, originated from a study visit to Komotau in Bohemia (Dick, 1889).

The models are also known from the Tinius Olsen school in Kongsberg as they visited Rjukan on a study tour in 1922. Kongsberg had received a private fund from Tinius Olsen testing Machine Co, Inc in 1921. The school in Kongsberg was started in 1946 with a one-year vocational school. Later, this school was expanded with more programs and engineering education from 1963 (Aakre, 2021).

On the course for mechanics, the teaching started with ordinary hand tools such as hammer and chisel and a lot of filing of blocks which could later be used in a vice or as a base for hammering. Gradually, the work became more demanding, as shown in Figure 1.

The course for carpenters largely built on existing courses in woodworking (sloyd) but lasted longer with its two years of training in school workshop. The works mostly consisted of furniture and furnishings in the form of chairs, tables, and cupboards (Figure 2a). However, they also made tools for their own use.

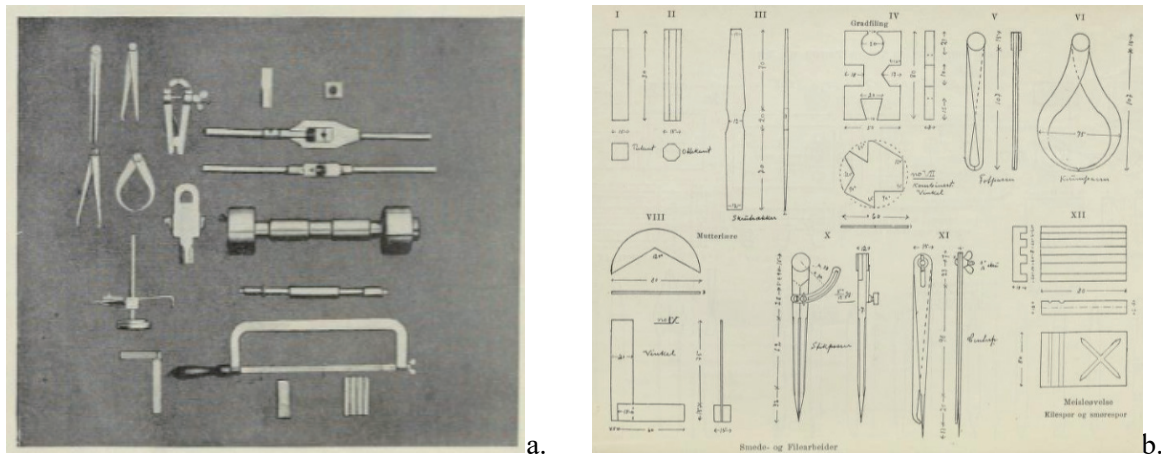


Figure 1. Practice series (a.) and drawing (b.) for mechanical course

In the carpentry course, there were fewer exercises with a total of 16. These have much in common with the exercise series that Otto Salomon developed for the teacher training in sloyd, which was established in Nääs outside Gothenburg in 1874. The exercise series for electricians, on the other hand, was more centered on the assembly, testing and maintenance of authentic facilities and fewer workpieces. One could say that it was closer to how the profession is practiced in practice.

In carpentry, teaching began with learning "skills" in sawing and planing, first of individual pieces and then of composite works, for example a stool. Later, chests of drawers and cupboards with and without shelves were added. At the end of the last year, students made their own tool cabinet and planing bench as a form of journeyman's piece (Figure 2b).

Most innovative and ahead of its time was the program for electricians, which included installations for both low and high voltage. In this program greater emphasis was placed on authentic installations and to a lesser extent models for pure practice. This was also the most popular program. It was partly related to the fact that the company Hydro was based on the production and use of electrical energy for industrial purposes. In the rest of society, there was also an increasing development and use of electricity for lighting, heating and electrical appliances and machines. Since few schools in Norway trained electricians at the time, the prospects for getting well-paid

work were good.

In the course for electricians more authentic tasks were used and less models for pure skilled training. A major advantage of this method was avoiding expenses for materials for pure exercises. Instead, the materials were used for something useful.

After an introduction of basic hammering, cutting, and chiseling the students started to do measurements and prepare materials for real installations. This included selection of correct winding wires for motors and generators, cables and pipes for installations and associated contacts and switches. Along the way, the necessary theory was introduced.

In the next step, devices were built, and installations set up to finally be started and tested. In this phase, it was also necessary to make measurements and troubleshoot if something had been done incorrectly. Along the way, suitable instruments and theory were introduced.

Finally, also assembly and testing of larger telecommunications and electrical systems. One of the final tasks was to design by drawing, installing, and testing a telephone system (Figure 3b). They also had practice and assisted service on the Vemork power station that was the world biggest at the time.

#### *The teacher and the teaching*

The teacher was then as now the most important person in the school and charged about 65% of the school's budget. The hourly wage



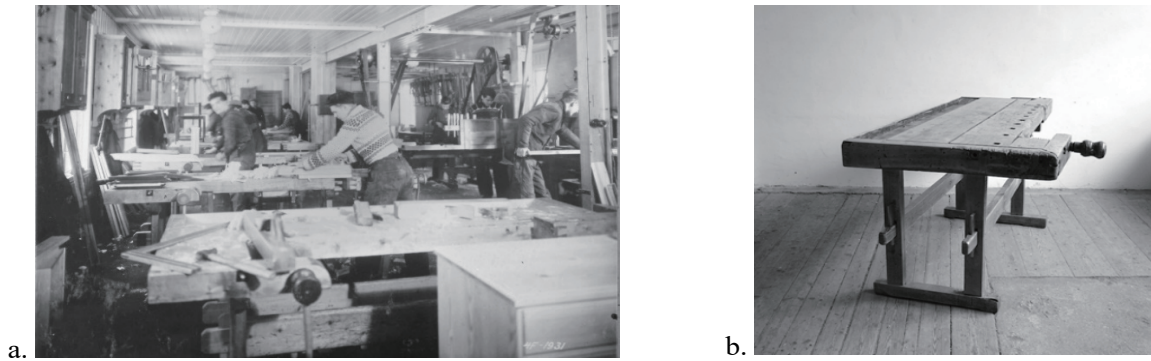


Figure 2. From the Carpentry workshop 1940 (a). Typical workbench (b).

was around NOK 5, though increased somewhat after 1945. But there was no teacher training for vocational teachers in Norway at the time when Rjukan apprentice school was established. It was common to employ an experienced engineer or skilled worker with good human qualities. Therefore, when it comes to education for vocational teachers, the school paved the way for the future with input and debates. The staff was very active and gave lectures for the first course for vocational teachers held in 1927. At the course, lectures and debates were held about pedagogy and content, and the relation between them through good planning (Lund, 1927). In the discussion that followed, some teachers argued that educational theory was not so important. They placed more emphasis on skills and professional competence, while others placed more emphasis on the pedagogical aspect with tasks that seemed motivating and interesting for the pupils. Others asserted that "a very skilled

worker often does not have enough patience with the students" (Foreman Sandholdt, 1927). They also tried to summarize the debate in what characterizes a good vocational teacher. She emphasized factors that most teacher educators today will recognize, such as:

- purely human characteristics, disposition, being, personality and character
- solid character and good warmth
- practical-professional skill, the practice
- teaching technique, ability to learn from oneself and to maintain discipline combined with great practical skill
- general and professional schooling and administration practice
- trial year, study tours and supplementary education
- into practice for 1-2 years, exchange with working life and visits to other schools also abroad

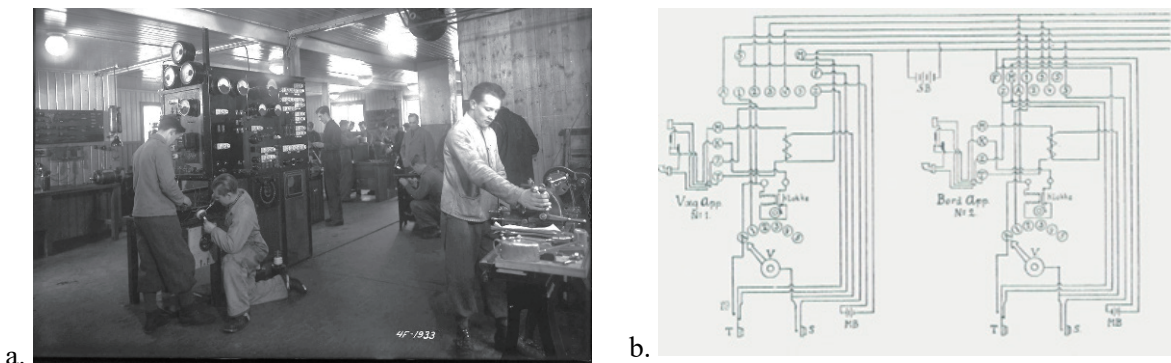


Figure 3. From Electrician workshop 1940 (a). Drawing of Telephone system (b.)

Principal Seelæg at Rjukan apprentice school highlighted their model where the teachers have 8 months of teaching and 4 months of practical work in the company. There is also an advantage for canceling holidays in companies. Furthermore, he believed that a piece of work can be done in several ways, but that wrong work can be caused too early in the practice sequence.

Furthermore, they concluded that every new subject teacher needs support and guidance from the headmaster, subject committee, colleagues, and the care of the board of governors. This could be done by keeping the teacher in touch with the workshops' technical progress, partly through trade journals, books, and company visits.

Principal Seelæg also initiated a debate about practice models. Among other things, he emphasized that they should be "completely carried out by the student himself, be evenly structured and adapted to the ability of the students". He further claimed that the exercises must provide variety and interest in the work. "The student loses interest if it becomes too monotonous," he concluded. He concluded that "boys like to make objects that they know can be turned into something useful". Therefore, the sequence of the products the students made was carefully planned. Objects made in the beginning of the school year should be possible to reuse later, even if it was just a block of wood or metal to be cut, planed, or filed.

Textbooks were also a topic: Many called for books that were written for and adapted to the school type and the student's ability. "Textbooks should be written by practitioners" claimed some, pointing out that books for engineering education were too theoretical for the age group. Others asked for a competition be announced for writing proper textbooks. Some teachers had examined foreign books, including German ones, but had not found any well suitable. The book "American Mechanist" had been translated by someone and used for teaching. Others argued that one should write Norwegian books instead of translating books from abroad.

#### *Assessment and examination*

The school drew up its own examination regulations which were approved by the board,

appointed by the Ministry of Education. Students were to be assessed formative along the course as well as summative in the form of an exam with an external examiner in all subjects. In a debate, one of the teachers stated that "if a boy doesn't understand anything, you have to explain it in a practical way. Verbal guidance is often better than written directives" (Mathisen, p.40). Emphasis was placed on the fact that the assessment had to take account of the student's prerequisites. A significant part of the assessment work therefore took place in the workshops while the students worked on a rehearsal or assembly. What we today call assessment for learning was practiced even then, although they did not have a technical term for it as we have today (Aakre, 2013).

The examination forms consisted of both practical, oral and written tests. The practical tests were based on assessment of the objects and drawings that the students had made throughout the year. These were also presented in the form of an exhibition that was open to the public at the end of each year.

A written exam was used in arithmetic, science (physics and chemistry) and materials science, while the electricians had an oral test in electrical engineering. Furthermore, grades were given for diligence, order and behavior.

The school used a 5-part grading scale with exceptionally good (Sg) as the best grade and not approved (IG) for those who did not pass the test. The last category was not transferred to 2nd class until a new test had been approved. The results were recorded on the school's diploma, signed and distributed at the closing ceremony, usually on 15<sup>th</sup> of May each year (IKA, 2023).

#### **8. From apprentice school to vocational school**

Rjukan apprentice school was established and was owned by Tinn municipality with support from the Government. Around 1920, the economy was relatively good, which was linked to high exports from Norsk Hydro. This gave the school good conditions in the first years. They received a solid budget to purchase equipment for the four modernly equipped classrooms, including their own forge. From Norsk Hydro, they received "Centralbrakka" free of charge and fully refurbished, as well as other benefits. But there

was also a boom with strong economic growth and inflation. This made the situation more difficult throughout the 1920s and passed into a period of crisis after the crash on the New York Stock Exchange in the autumn of 1929. Table 1 reflects this development in numbers.

At the beginning of the 1930s, there was a time of crisis in Norway and the world, with heavy unemployment and poverty. It also affected Rjukan, as Hydro was a large export company. This led to a decrease in funding for the school at the same time as applications increased sharply. In 1931, the number of applicants for the new ordinary first class had increased from 46 to 111, more than twice as many as the previous year. At the same time, demands were raised for education for new subjects such as car mechanics and painters and more seats in the 3-year technical evening school, which provided theory during the apprenticeship for those at work. Applications to the ordinary program remained high throughout the 1930s, with a peak of 122 applicants in 1938. But then came the first crisis measures with funds for an extra class for mechanics (Mek. B) and various shorter courses. There was a new upswing and optimism while the threat of war increased in Europe. On 9th April 1940, Norway was also occupied and dragged into the war. It hit Rjukan hard.

One of the things that characterized the war years was a series of decrees from the Quisling government. It concerned contributions to the armed forces in the form of metals, rationing of firewood and other necessary goods. There was an ordinance on exemptions for students who wanted to participate in the Nazi Hirden and the obligation to have notices and posters about Quisling's "Nationalist Party" at school. Other posters were strictly prohibited. Fire drills and courses on how to deal with air raids also became mandatory. The first bomb attacks against the heavy water factory took place on 28<sup>th</sup> of February 1943. The battle for the heavy water (D2O), which was supposed to prevent the Germans from developing an atomic bomb, has been documented in both books, videos and films. The most famous is *Heroes of Telemark* with Kirk Douglas, Richard Harris and Ulla Jacobsson in the lead roles. The heavy water factory was

blown up and left in ruins but has recently been rebuilt and has become a new attraction at the Norwegian Industrial Workers Museum (NIA, 2023). It is located at the old hydroelectric powerplant in Vemork by Rjukanfossen, which gave life to the city and the school, a little west of Rjukan.

In a meeting on 4<sup>th</sup> of June 1945, the board of the school dealt with matters regarding the reinstatement and removal of Nazi teachers and pupils based on directives from the government. It was part of the settlement after the war. But no information is given about concrete names (IKA, 2023).

## 8. The educational expansion

In the years after the Second World War, there has been a great educational expansion in Norway (Grøgaard and Støren, 2006). It also included a large investment in vocational education to meet the labor market's need for qualified labor (Aakre, 2020, p.25). Much was already prepared in the 1930s, but it ran aground on funds and prioritization. In 1933, the Vocational Training Council had been established and proposals were put forward for a more holistic vocational training anchored in a new law. After the crisis settlement between the Labor Party and the Farmers' Party in 1935, employment and education were given higher priority. At the same time, the economy improved, and it became possible to focus more on public tasks such as education. A new National curriculum for the Folkeskolen (N39) was adopted in 1939 and in 1940 a new Act on Vocational Schools for Craft and Industry (Loc, 1940). Rjukan apprentice school was also an early adopter in that they already started preparing for the transition to the new vocational school system in 1939. Already in 1942, before all others, Rjukan apprentice school and Rjukan technical evening school, were coordinated through an increase in lesson hours as required by the new law. This took place a few years before the implementation of the law on national bases began from 1946. Rjukan apprentice school then became Rjukan vocational school. With the new model, the need for space also increased and work was started to build a new school. It was completed in 1953 when all vocational education

Table 2. Rjukan vocational school 1921-46. (Estimated values).

Year	Budget	Subsidy	Teacher salary pr. hr	Investments	Number of students (Applicants)
1921	75.250	25.250	4,8	29.250	46 (48)
1922-1931	45.000	20.000	5	8.500	46 (~60)
1932-1941	35.000	10.000	5	4.500	46 (~115). +Mek. B in 1938 +Course
1942-1946	40.000	12.000	5,20	6.000	74 +Technical evening school
1946	54.373	24.250	5,50	10.000	104 (incl. apprentices)
1946-1953	Following the new Normal Curriculum, a new joint vocational school is being built, which will be put into use in the autumn of 1953				

for both boys and girls was coordinated in one and the same school building. This integration can also stand as an example of the coordination of education that took place in Norway after the Second World War in 1945 (Aakre, 2005, p. 109).

This coordination and the development of a common upper secondary education for all continued in the years that followed. Today it is named Rjukan videregående skole (2023) with both vocational and general programs. However, in the 1960s, Rjukan experienced difficult years of restructuring. New technology made it possible to transfer electrical energy over longer distances without loss. To be more competitive, Hydro therefore moved large parts of its production to Porsgrunn, close to the coast with a good harbor for large ships. Therefore, Porsgrunn became the campus for University of South-Eastern Norway (USN), not Rjukan.

Since 1994, vocational education and training (VET) in Norway has broadly continued the model that was established at Rjukan in 1921, with 2 years of theory and practice in a school and 1 or 2 years of guided apprentice training in a company before taking the journeyman exam.

## 9. Conclusion

Based on this survey, Rjukan apprentice school appears interesting and ahead of its time. Firstly, it took as its starting point the social conditions in an urban society and the young people's needs and interests. The school was based on the idea of learning through work and combining theory with practice. They emphasized not only theoretical knowledge, but also practical skills and work ethics relevant for professional work. Secondly, they insisted on a dual model with practical

and theoretical training in both a school and a company.

Thirdly, the school board from the beginning insisted on a model with two years of practical and theoretical training in schools where students could enter directly from primary school without any delay. This was justified, among other things, by avoiding idleness and the social problems it may entail in an urban society with few opportunities for work at a young age. New safety regulations in professions like electricians also became an obstacle for young workers. These were new ideas at the time and the 2+1 model was eventually approved by the Ministry of Education. Initially as a trial project, but gradually over years it became the national model.

The staff at Rjukan apprentice school was also active in designing the first courses for vocational teachers and they gave input into the design of future vocational training in Norway. They also gave input for the new law on vocational education passed in March 1940. In spite of the war that stopped the implementation on national bases, Rjukan started to implement this law long before most other schools in Norway.

Finally, the establishment of Rjukan apprentice school must be understood in the light of the special conditions that characterized society in Rjukan: rapid industrialization, urbanization, technological progress and major fluctuations in the economy. In addition, the school's first year mirrors a national project to establish comprehensive vocational training from basic education to higher education. Today all upper secondary education is coordinated in the same buildings with both vocational and general



programs.

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