

# **Technology and theory of research - programme subject in programmes for Specialization in General Studies**

Dette er en oversettelse av den fastsatte læreplanteksten. Læreplanen er fastsatt på Bokmål

Laid down as a regulation by the Norwegian Directorate for Education and Training on 6 April 2006, as delegated in a letter of 26 September 2005 from the Ministry of Education and Research pursuant to the Act of 17 July 1998 no. 61 relating to primary and secondary education (Education Act) Section 3-4 first paragraph.

Valid from 01.08.2006

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## Purpose

Technology and research are part of our cultural background, forming the basis for our standard of living. Professional and theoretical knowledge, combined with the capacity for creative and innovative thinking, is becoming more important in social and business life. Innovation through the use of technology and experimental work takes on greater importance in a time when technology is making ever greater inroads in many areas of working life and private life. All societies need technical and scientific expertise to ensure their future well-being. Research-based knowledge development tends to be broad-based, as technological innovation is ongoing. Technology and theory of research represents two unique fields of knowledge, yet can be seen as closely related fields. This programme subject shall help show how interaction between these fields creates an arena for creativity and innovation.

This programme subject shall serve as a basis for insight into scientific and technological challenges and social problems. It shall attempt to provide a general understanding of the developing technologies and sciences, also showing that ethical challenges do arise. At the same time, this programme subject shall form the basis for evaluating and discussing technological products and their effects on society.

This programme subject shall give the pupil experience with practical application of the natural sciences and mathematics, and create an arena for wonder and curiosity. It shall also give an insight into scientific theory and philosophy seen from a historical perspective, and help increase the awareness of our own place in time and space.

Teaching in this subject shall also provide learning arenas outside of school, in association with research communities and businesses. To ensure good learning in this subject, practical and theoretical approaches to learning shall be used that emphasize construction and experimenting using technological devices. This programme subject forms the basis for future studies and future employment, but also for increased participation in current debates.

## Structure

Technology and theory of research consists of three programme subjects: Technology and theory of research 1, Technology and theory of research 2 and Technology and theory of research X. Technology and theory of research 1 and Technology and theory of research 2 are built up so that one can choose either one independently of the other.

Technology and theory of research X is especially designed for pupils at level Vg2 who choose Mathematics as a programme subject. Only Technology and theory of research 1 and Technology and theory of research 2 give complete specialization.

Technology and theory of research 1 and Technology and theory of research X have three main subject areas in common: The young engineer, The young researcher and Technology, science and society.

Technology and theory of research 1 also covers main subject area of Design and product development.

These programme subjects have been structured into main subject areas, for which competence aims have been formulated. These subject areas complement each other, and should be viewed in relation to one another.

### **Overview of the main subject areas:**

<b>Programme subject</b>	<b>Main subject areas</b>			
Technology and theory of research X		The young engineer	The young researcher	Technology, science and society
Technology and theory of research 1	Design and product development			
Technology and theory of research 2	Scientific working methods	Research, technology, and society	The young researcher	The philosophy of science and scientific theory

## Main subject areas

### Technology and theory of research X

#### The young engineer

This main subject area deals with technology in its creative and practical contexts. The planning, building and testing of technological products are included here. This subject also covers the use of fundamental engineering tools and materials, their methods of construction, and the use of sensors and guidance/monitoring systems. It also deals with evaluating the product's functionalities.

#### The young researcher

This main subject area deals with scientific investigations in relevant subjects related to health and the environment and how these investigations are planned, carried out and presented. Also covered are systematic methods of measurement and the analysis of results.

### Technology, science and society

This main subject area deals with science and technology from a social perspective. Essential themes in this main subject area are the historical development and evaluation of environmental, cultural and ethical challenges associated with technological innovation. This main subject area also covers the principles and workings of technological devices.

### Technology and theory of research 1

#### Design and product development

This main subject area deals with product development. It covers work on electronic circuits and how they can be used to develop products based on one's own ideas. Basic themes in this main subject area are testing or simulation, experimenting, scaling and evaluating the quality of the finished product with a view to its form, function, aesthetic qualities and environmental aspects.

#### The young engineer

This main subject area deals with technology in its creative and practical contexts. Planning, building and testing technological products are included here. This subject also covers the use of basic engineering tools and materials and their methods of construction, and the use of sensors and guidance and control systems. It also deals with evaluating the product's functionalities.

### **The young researcher**

This main subject area deals with scientific investigation around relevant subjects related to health and the environment and how these kinds of investigations are planned, carried out and presented. Also covered are systematic methods of measurement and the analysis of results.

### **Technology, science and society**

This main subject area deals with science and technology from a social perspective. Essential themes are the historical development and evaluation of environmental, cultural and ethical challenges associated with technological innovation. Also encompassed are the principles and workings of technological devices.

### **Technology and theory of research 2**

#### **Scientific working methods**

This main subject area deals with fundamental working methods used in the natural sciences. This subject also covers the relationship between empiricism and theory, and how knowledge develops and is published in research communities.

#### **Research, technology, and society**

This main subject area deals with the interaction between science, technology and society. This subject also deals with technological and scientific activities placed in their economic, environmental and ethical contexts. This main subject area also deals with how research results and new technology are communicated to society by the media and special interest groups.

### **The young researcher**

This main subject area deals with the formulation of problems, planning and carrying out scientific investigations. Experimentation, presentation and critical evaluation of results are included in this main subject area.

### **The philosophy of science and scientific theory**

This main subject area deals with ideas and thoughts that form the basis of science and with the role of technology in these developments. This subject also concerns understanding the basis for argumentation in current scientific debates.

## **Teaching hours**

Teaching hours are given in 60-minute units.

Technology and theory of research X: 84 teaching hours per year

Technology and theory of research 1: 140 teaching hours per year

Technology and theory of research 2: 140 teaching hours per year

## Basic skills

Basic skills are integrated into the competence aims for this course in areas where they contribute to the development of and are a part of the basic subject competences. In the Technology and theory of research programme subject, basic skills are understood as follows:

*To be able to express oneself orally and in writing* in Technology and theory of research implies using precise formulations, professional terminology and mathematical forms of expression. It also means developing hypotheses, keeping notes and reporting on procedural methods and results from research work, and evaluating others' work by giving constructive feedback. It also means giving subject-specific information in the form of tables, graphs, figures and mathematical symbol language.

*To be able to read* in Technology and theory of research implies extracting, interpreting and reflection over information from technical and scientific texts and digital mediums. It also means understanding user manuals, recipes, tables, diagrams and symbols.

*Numeracy* in Technology and theory of research implies using numbers and calculations for registering and handling results from observations and measurements, and presenting these in the form of tables and diagrams. It also means interpreting and using formulas and models. In laboratories and workshops, this implies calculating unit measurements, changing formula expressions, evaluating information in graphic form, doing uncertainty calculations and using mathematical models.

*To be able to use digital tools* in Technology and theory of research implies using digital registration tools for monitoring and control of experiments, simulations and gathering data. Documentation and publication using multimedia aids is also included in this subject. It also means using digital tools to develop models, calculate values, reformulate expressions and scaling.

## Competence aims

### Technology and theory of research X

#### The young engineer

*The aims of the studies are to enable pupils to*

- plan and build a fixed or movable construction that has a specific function
- use three-dimensional drawings or sketches in developing constructions
- use different materials and ways of joining these together, and give grounds for choice of materials and construction methods based on material properties and the function of the construction itself
- use sensors and guidance-and-control systems in connection with experiments and constructions
- document and evaluate the construction's physical properties and functionality by means of measurements and simple calculations

#### The young researcher

*The aims of the studies are to enable pupils to*

- give an account of how a scientific project is planned, carried out and followed up before being published
- plan, carry out, analyse and document systematic measurements for noise, air pollution, indoor climates and water quality, and elaborate on and discuss climatic and health-related effects

## **Technology, science and society**

*The aims of the studies are to enable pupils to*

- elaborate on and discuss ethical, environmental, cultural and political aspects of technological development
- describe the historical development of technological devices, explain how some work, and elaborate on and discuss their application and use in society
- give an account of development and production of a technological product, and evaluate the product's user-friendliness, developmental possibilities and environmental effects
- describe the principles and workings of some modern instruments within the field of industry, health institutions or research, and give an account of its usefulness or possible harmful effects
- map out and present practical use of science and mathematics in a local company or institution

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- describe the principles and workings of some modern instruments within the field of industry, health or research, and give an account of their usefulness or possible harmful effects
- map out and present practical use of science and mathematics in a local company or institution

## **Design and product development**

*The aims of the studies are to enable pupils to*

- give an account of the function of common components in electronic circuits, and recognize the components in a circuit
- make electronic circuits by soldering components, and simulate and test the circuits
- design and develop products that have a defined function and contain electronics
- document and present design processes, from idea to finished product
- give grounds for material choice in products, and evaluate its form and function, environmental consequences and aesthetics, and show possibilities for improvement of these products
- carry out measurements with, or test their own product, and evaluate the quality of the product with a view to functionality

## **Technology and theory of research 2**

### **The young researcher**

*The aims of the studies are to enable pupils to*

- give an account of a research project in a company or institution, and describe problems, organization, measuring equipment, results and financing of this
- plan and execute scientific investigations based on their own ideas, and present this in scientific form
- elaborate on and discuss results from their own investigations related to relevant knowledge in the field, and evaluate how control of variables and reproducibility is upheld

### **Scientific working methods**

*The aims of the studies are to enable pupils to*

- explain what is meant by model, theory and hypothesis, and give an account of how these are used and developed in research
- elaborate on and discuss by using examples of how empirical data can confirm/negate a hypothesis
- give an account of how research develops, and how quality is assured through cooperation, critical evaluations and argumentation
- give an account of the structure of scientific publications or presentations

### **Research, technology, and society**

*The aims of the studies are to enable pupils to*

- describe the characteristics of basic research, applied research and development work, and give an account of the main features of financing and controls

- give an account of the significance that scientific research and technological development have for business and society
- elaborate on and discuss economic, environmental and ethical questions associated with scientific research and technological development
- discuss, elaborate on and give examples of how results from research, and new technology, are transmitted and used by research institutions, media, companies, special interest groups and public authorities

## The philosophy of science and scientific theory

*The aims of the studies are to enable pupils to*

- describe the main features of the historical development of scientific thinking, and elaborate on and discuss the role of technology in this development
- give an account of the main ideas of some prominent scientific theoreticians and scientific philosophers
- evaluate how argumentation in current scientific debate rests on empirical results, theoretical knowledge and ideological points of view

## Assessment

Provisions for final assessment:

### Overall achievement grades

Programme subject	Provision
Technology and theory of research X	The pupils shall have an overall achievement mark.
Technology and theory of research 1	The pupils shall have an overall achievement mark.
Technology and theory of research 2	The pupils shall have an overall achievement mark.

### Examination for pupils

Programme subject	Provision
Technology and theory of research X	The pupils may be selected for an oral-practical exam.
	The exam is prepared and marked locally.
Technology and theory of research 1	The pupils may be selected for an oral-practical exam.
	The exam is prepared and marked locally.
Technology and theory of research 2	The pupils may be selected for a written or an oral-practical exam. The written exam is prepared and marked centrally.
	The oral-practical exam is prepared and marked locally.

### External candidates exams

Programme subject	Provision
Technology and theory of research X	External candidates shall appear for an oral-practical exam.
	The oral exam is prepared and marked locally.
Technology and theory of research 1	External candidates shall appear for an oral-practical exam.
	The oral exam is prepared and marked locally.
Technology and theory of	External candidates shall appear for a written and oral-practical exam. The written exam is prepared and marked centrally. The oral-practical exam is



research 2	prepared and marked locally.
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The provisions for assessment are stipulated in the regulations of the Norwegian Education Act.