

The NTNU project

# Technology education of the future (FTS)

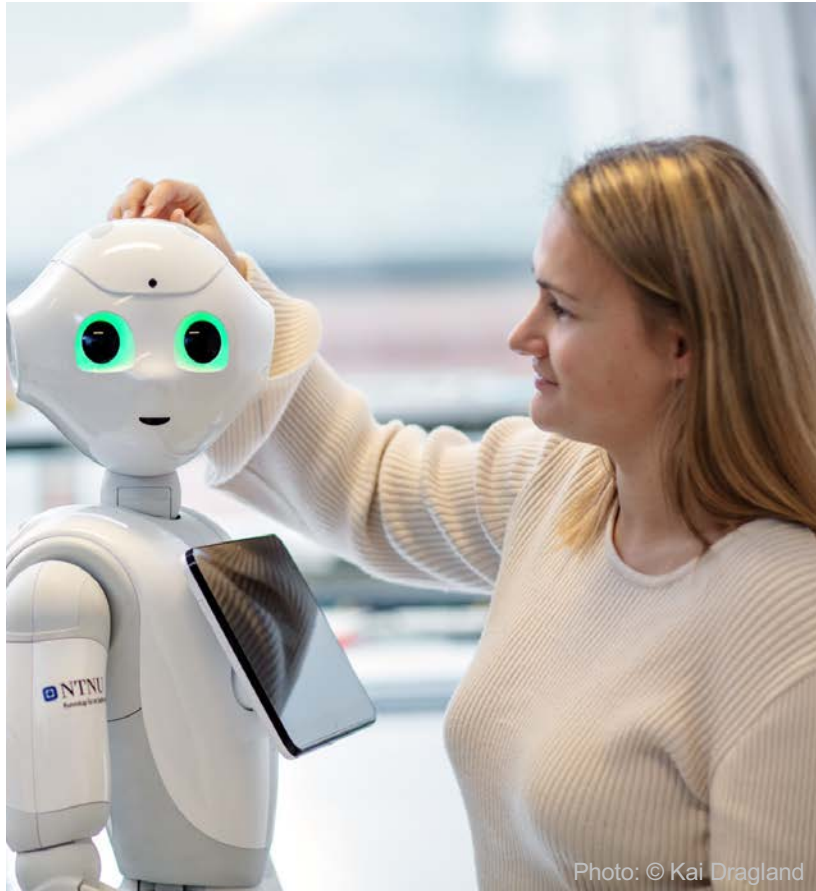
*Keynote, CDIO Europe-UK&Ireland Regional Meeting 2021*

Prof. Geir Egil Dahle Øien, Project Manager



NTNU

FREMTIDENS  
TEKNOLOGISTUDIER



## What is the FTS project about?

*The aim is to develop NTNU's engineering and science education*

*- to be in line with technological progress, societal challenges, and job market needs from 2025 onwards.*

The first phase has seen development of **competence profiles** and **guiding principles for development**, based on

- a review of international state-of-the-art in technology education,
- a SWOT analysis of NTNU's current portfolio of technology programs
- expectations expressed from key stakeholders
- NTNU's own strategic ambitions.

# FTS scope

Based on reviews of relevant facts, needs, and trends, FTS shall:

*...recommend a framework for development of NTNU's future study program portfolio within technology.*

The term *technology* here entails

- Classical engineering and technology programs
- Technology-oriented natural science programs
- Architecture, design, and planning programs

... on the bachelor, master's and PhD level.

- *In all, ~150 study programs in the FTS portfolio!*

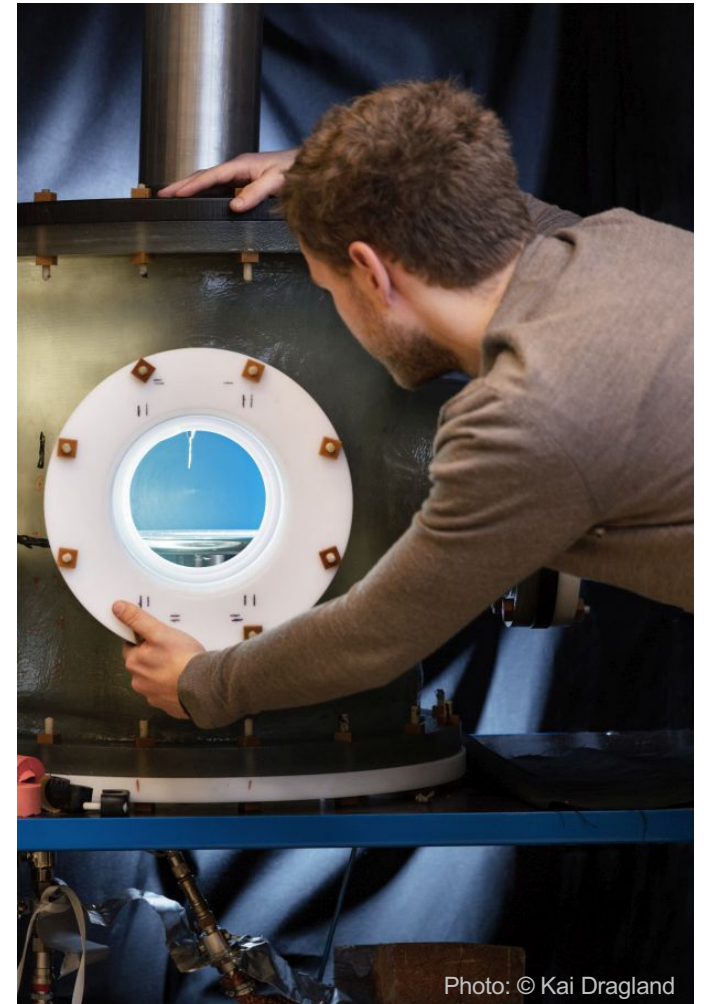


Photo: © Kai Dragland

# FTS: Plan and organization

## Phase 1: Background reviews and main concepts

- August 2019–December 2020

## Phase 2: Practical consequences - towards implementation

- October 2020–December 2021

Project owner: Vice-rector of education, Marit Reitan

Project manager: Professor Geir Egil Dahle Øien

Coordinator: Senior advisor Nils Rune Bodsberg



### NORDIC REFERENCE GROUP:

*Martin P. Bendsøe, DTU (prof. em.)*

*Kristina Edström, KTH*

*Jan Gulliksen, KTH*

*Anette Kolmos, Aalborg U.*

*Per Warfvinge, Lund U.*

Photo: © Kai Dragland

FREMTIDENS TEKNOLOGISTUDIER



# Strategic Vision (proposal)

***NTNU's technology programs graduate  
creative world-class students  
able and willing to contribute  
to a better world and a sustainable future***



Photo: © Kai Dragland

# Phase 1: Subproject 1

## Strengths and weaknesses of today's study program portfolio

### Goals:

- *Identify and describe – in an international perspective – important current strengths and weaknesses of NTNU's technology programs, and analyse trends and possible causalities.*
- *Recommend how NTNU should navigate to alleviate important weaknesses without losing important strengths.*



Photo: © Kai Dragland

# Key strengths and opportunities (1)

NTNU very strong national brand – with excellent reputation, and dominating position in technology

Overall very good student recruitment and high attractivity

Alumni and employers find NTNU's education relevant, and students attractive

High overall satisfaction with NTNU students' technical knowledge

Overall very good scores on student health and well-being

Strong institutional focus on scientific quality and research excellence

## Key strengths and opportunities (2)

Rich and diverse  
collaboration  
with industry and  
public sector

Major ongoing  
campus development project  
–  
an opportunity to design  
new, modern learning spaces

Good conditions  
for individual  
teacher-student contact  
on today's campus

Strong tradition for  
strategic  
cross-departmental  
coordination  
of technology  
program portfolio

Well-designed  
multi-campus coordination  
may increase  
cross-city collaboration  
and enhance quality

Ambitious plans  
recently adopted  
for enhancement of  
learning support and  
faculty competence  
development



# Some weaknesses, risks and challenges (1)

Competence as a holistic concept (beyond technical knowledge) is still novel and unfamiliar to many teachers

On some important «21st century competencies», NTNU alumni and students self-assess their learning outcome as fairly weak

Students judge NTNU's technology programs to have less student-active teaching than the national average for such programs

NTNU technology students are less satisfied with teacher feedback and supervision than comparable students at other Norwegian schools

Written final exams (paper or digital) are still the dominating assessment method at NTNU

NTNU does not express clear expectations towards, and lacks strong support for, career-long development of faculty's pedagogical and profession-related competence

## Some weaknesses, risks and challenges (2)

Increased online teaching, lack of physical interaction, and reduced campus presence may negatively impact learning outcomes, learning environment, health and well-being

Capacity limitations in space and time limit students' choices, and complicate logistics of designing teaching and exam plans

Organization of education leadership at NTNU can appear complex, and the Program Manager role is not yet fully developed

No obligatory work practice integrated in today's technology programs - contrary to wishes from students and employers

NTNU's portfolio of lifelong learning offerings within technology & engineering is quite limited

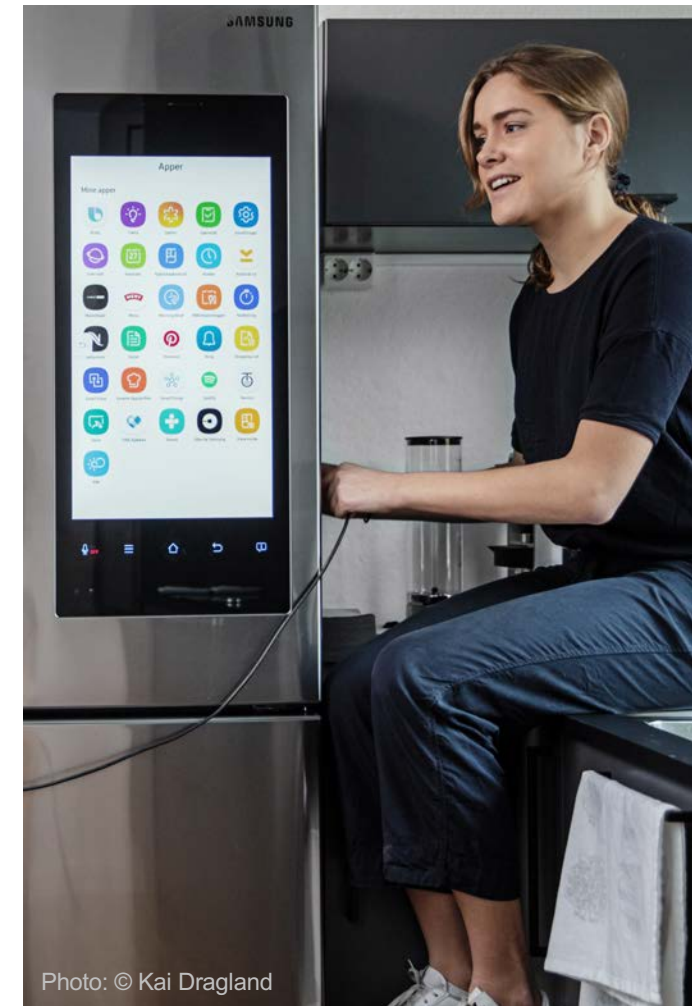
NTNU has low international visibility and impact when it comes to (research on) quality development in technology education

# Phase 1: Subproject 2

## Desired competence profiles and guiding principles for tomorrow's technology programs

### Goals:

- *Identify and recommend competence profiles for future graduates from NTNU's technology programs at bachelor, master, and PhD level.*
- *Recommend guiding principles suitable as foundation for future development of NTNU's technology programs, in order to ensure realization of desired competence profiles.*



# Most important trends influencing the competence needs of NTNU graduates towards 2030



**The need for sustainable development and a green shift**



**Increasing volatility, complexity, uncertainty, unpredictability («VUCA world»)**



**Digital transformation as a main driver of change in all societal sectors – ever faster**



**Increased need for entrepreneurial mindset, user orientation, design competence – engineers as change agents**



**Capacity for lifelong learning - a central competence for all**

# Competence: More than knowledge!

«The concept of competency implies more than just the acquisition of knowledge and skills; it involves the mobilisation of knowledge, skills, attitudes and values to meet complex demands.»

- «The future of Education and Skills: Education 2030»,  
OECD

## 4-D Framework

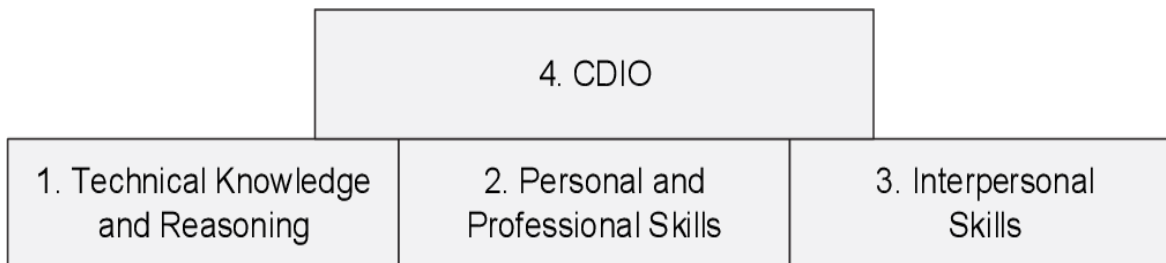
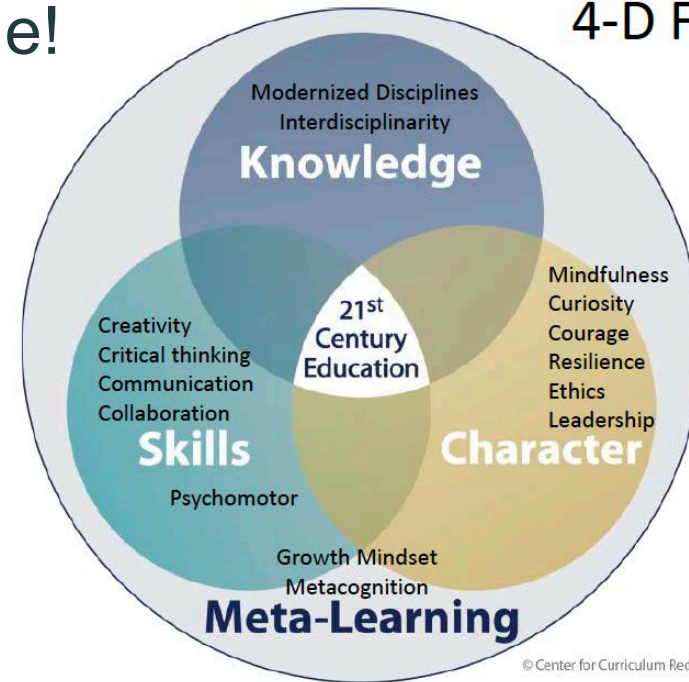


Figure 1. The four sections of the CDIO Syllabus (Crawley 2001).



The proposed FTS competence profiles, visualized

(profile for engineering study programs)

**THE FOUNDATION:** Demonstrate strong knowledge in, and professional perspective based on,

- The theoretical tools and disciplinary fundamentals of engineering
- In-depth knowledge of own engineering specialization
- Supplementary knowledge from other engineering fields
- Complementary knowledge from other knowledge fields, giving a broader perspective on engineering and technology

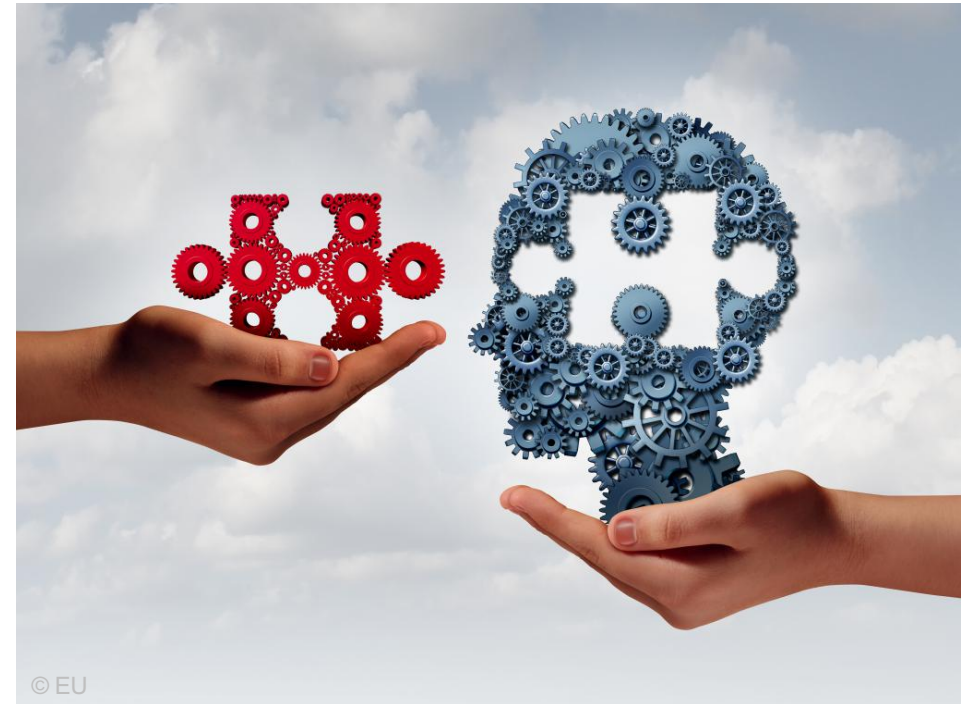
# 10 recommendations regarding guiding principles (I)

(revised, not-finalized proposal as of Jan. 7 2021, after stakeholder hearing process Sept. – Nov. 2020)

## **COMPETENCE AND KNOWLEDGE:**

### ***The FTS project recommends that***

- NTNU's technology programs, based on a foundation of strong professional knowledge, actively facilitate students' acquisition of ***holistic and integrated competence***, including ***sustainability competence and digital competence*** at a high level.
- NTNU actively facilitates all technology students' acquisition of ***cross-disciplinary collaboration competence***, and develops a diverse menu of ***complementary knowledge profiles*** – without diluting individual students' technical depth of knowledge.



FREMTIDENS TEKNOLOGISTUDIER

# 10 recommendations regarding guiding principles (II)

(revised, not-finalized proposal as of Jan. 7 2021, after stakeholder hearing process Sept. – Nov. 2020)

## **PEDAGOGY, LEARNING, AND FACULTY DEVELOPMENT:**

*The FTS project recommends that*

- **Contextual learning** is established as an underlying pedagogical principle in NTNU's technology programs.
- NTNU's technology programs use **knowledge-based, student-active, and varied teaching and assessment methods** - constructively aligned with competence goals, promoting a healthy learning culture, and facilitating in-depth learning.
- NTNU expresses clear **expectations** towards, and provides solid **support** for, **career-long competence development among faculty**.



© Andrew Krasovitchkii/Shutterstock.com

FREMTIDENS TEKNOLOGISTUDIER

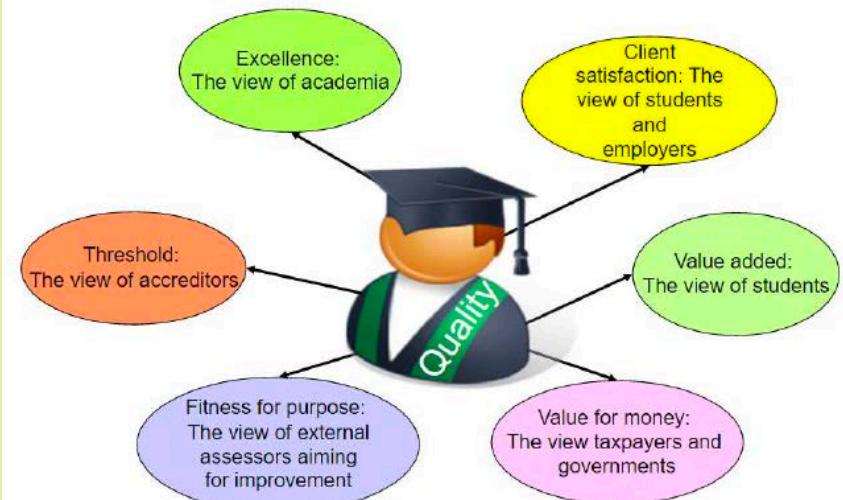
# 10 recommendations regarding guiding principles (III)

(revised, not-finalized proposal as of Jan. 7 2021, after stakeholder hearing process Sept. – Nov. 2020)

## QUALITY DEVELOPMENT PHILOSOPHY:

### The FTS project recommends that

- A **program-driven approach** is taken to quality development in NTNU's technology education - in combination with **strategic portfolio development and governance** across programs and program types.
- NTNU's quality development work in the technology programs focuses on **continuous improvement and systematic development of quality culture**, with an aim towards world-class educational quality.



Source: Green, D. What is Quality in Higher Education? Concepts, Policy and Practice 1994

# 10 recommendations regarding guiding principles (IV)

(revised, not-finalized proposal as of Jan. 7 2021, after stakeholder hearing process Sept. – Nov. 2020)

## **INFRASTRUCTURE:**

*The FTS project recommends that*

- NTNU develops its **physical and digital campus and infrastructure** specifically to **support the FTS recommendations** – and promote learning, health, and well-being among students and employees.



## **INTERACTION AND COLLABORATION:**

*The FTS project recommends that*

- NTNU further strengthens the technology programs' **systematic interaction with employers and society at large**, with specific aims to promote **work relevance**, strengthen **lifelong learning**, and improve students' **professional experience opportunities**.
- NTNU gives high priority to **international collaboration on technology education development** - with an ambition of international recognition and impact also in this field.





# FTS and CDIO?



- NTNU has been a CDIO member since Nov. 2016 – but has so far not systematically adopted the CDIO methodology, or engaged heavily in the CDIO community.
- ... however, in sum, the FTS recommendations bear considerable resemblance to the CDIO standards!
- CDIO has also been one of the major inspirations throughout the FTS work – and may be a great support for NTNU when implementation starts.

- ... however, not all study programs in the FTS portfolio are profession-oriented engineering programs – and the program portfolio covers both bachelor, master, and PhD programs...

- ***How to make good use of the CDIO ideas, methodology and community in this wider context?***

# Future work - 1 (proposal for Spring 2021 – not finalized)

Improve differentiation of  
FTS competence profiles  
between different  
program types and levels

Survey and recommendations wrt.  
specific pedagogical tools and  
approaches  
suitable for supporting  
the FTS competence goals

Survey and recommendations  
wrt. practical consequences of a  
more program-driven approach  
in education quality development

Survey and recommendations wrt. the  
possible need for specific changes  
in structure, organization, and  
governance  
of the FTS program portfolio

## Future work - 2 (proposal for Spring 2021 – not finalized)

Survey and recommendations wrt. resource needs and prioritization in implementation of FTS recommendations

Piloting of selected educational initiatives which support the FTS recommendations

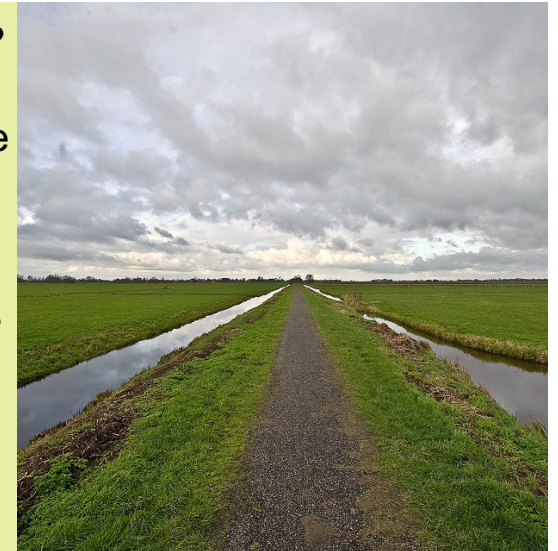
FTS participation in already ongoing processes:

- Campus development
- Organizational competence development and support for learning
- Lifelong learning and work relevance
- The EU project *ENHANCE - European Universities of Technology Alliance*

Webinar series to increase knowledge about CDIO at NTNU

# Challenges and possible pitfalls ...

- Are we able to establish a «sense of urgency» which motivates for real change?
- Are we able to establish a joint internal understanding of today's status - and the direction of change needed?
- How to navigate between the two ditches «*Aren't we doing all of this already?*» and «*We apparently need to change everything, which is not realistic anyway?*»?
- How to balance «need to have» and «nice to have» - maintaining both a sense of realism (doable in practice) and high ambition (stretch targets)?
- How to uphold NTNU's (many and important) strengths - while alleviating important weaknesses?
- How to develop a robust methodology for real change – going from «WHAT» to «HOW»!
- COVID-19...
  - Unpredictability and lack of organizational capacity
  - + Emphasizes the need to change anyway («Never waste a good crisis!»)



# THANK YOU!

Follow the FTS project progress on [ntnu.no/fremtidensteknologistudier](https://ntnu.no/fremtidensteknologistudier)



Photo: © Kai Dragland

 NTNU

 FREMTIDENS TEKNOLOGISTUDIER 