



Integrating Sustainability Competence into Tomorrow's Technology Education Programs

*Webinar on Sustainability in Education
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NTNU

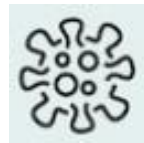
**FREMTIDENS
TEKNOLOGISTUDIER (FTS)**



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

Strategic vision, FTS

NTNU's technology programs graduate

creative world-class students

able and willing to contribute

to a better world and a **sustainable future**



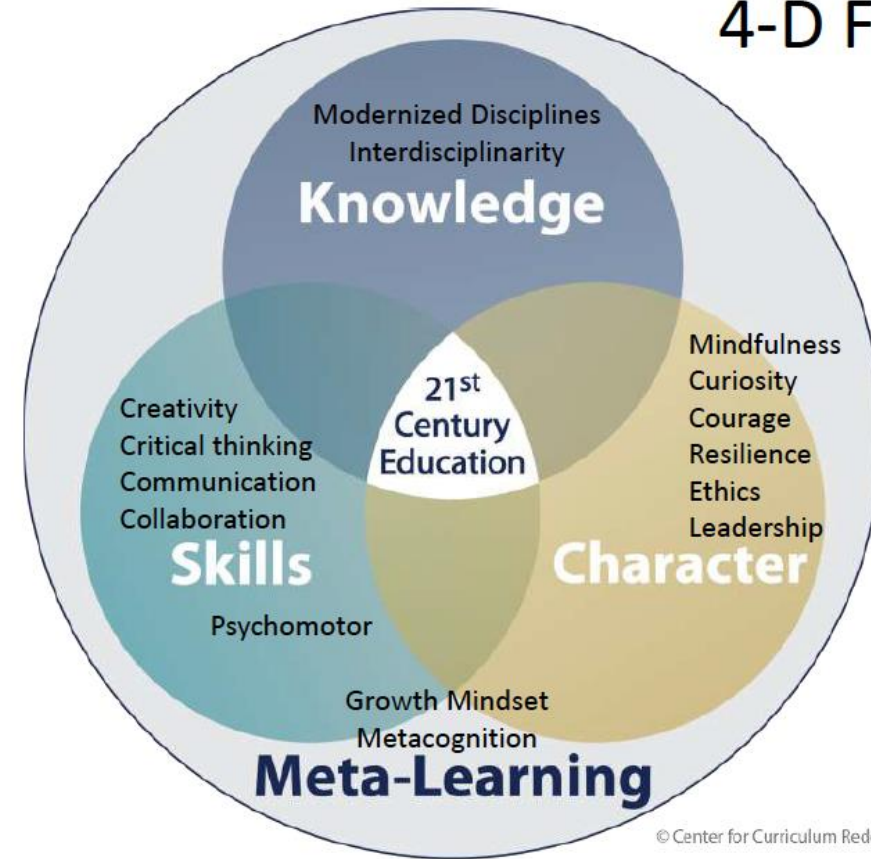
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The main FTS recommendation regarding future graduates' competence

The FTS project recommends that

NTNU's technology programs, based on a solid knowledge foundation, actively facilitate students' acquisition of ***holistic and integrated competence***, including ***sustainability competence*** and ***digital competence*** on a high level.

4-D Framework



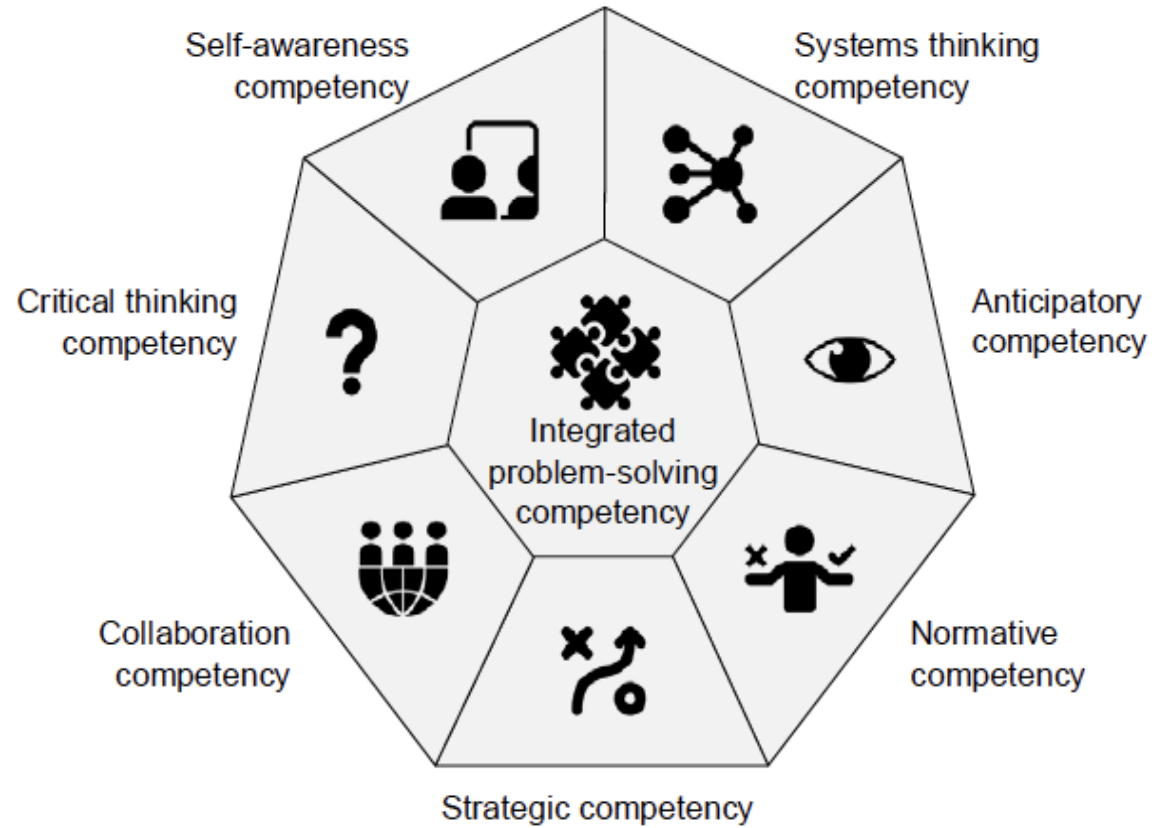
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«The concept of competency implies more than just the acquisition of knowledge and skills; it involves the mobilisation of knowledge, skills, attitudes and values to meet complex demands.»

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

8 «key sustainability competencies» identified by UNESCO

<https://en.unesco.org/themes/education-sustainable-development>



Proceedings of the 15th International CDIO Conference, Aarhus University, Aarhus, Denmark, June 25 – 27, 2019.



GLOBAL SUSTAINABLE
DEVELOPMENT REPORT

2019

Sustainability competence must be built on a foundation of (shared + programme-specific) KNOWLEDGE ...:

- Understanding «the three pillars»: Ecological, economic, and social sustainability
- What are the most important sustainability challenges? (Climate change, loss of biodiversity, inequality ...)
- Technological and systemic limits
- Environmental analysis methodologies (process, product, organizational, national, global level ...)
- Designing for sustainability - circular modelling
- Governance principles + environmental-related health and safety issues
- Value chain thinking and globalization
- Understanding how different technologies may influence the SDGs
- Historical development – green strategies
- ...

How to facilitate in education programmes? Some tools and guidelines ...

- ***Integrated curriculum:*** Mutually supporting courses – coordinated to support an overarching goal of sustainability competence on programme level
- ***Integrated learning:*** Exploit «dual use of time» to develop several sustainability competence dimensions in parallel - by proper choice of learning activities and assessment methods
- ***Contextual, student-active learning:*** Increase project- and case-based learning, «design-implement» experiences, problem-based learning with authentic («wicked») problems, and cross-disciplinary collaboration – with sustainability concerns as a central premise
- + dedicated courses, minors, profiles, programmes ...

Example 1: Integration of sustainability in BSc programme Mechanical engineering, KTH (Sweden)

Program driven development

Integration of sustainable development

- Lecture: Introduction to sustainable development
- Product development project: Reflecting on the environmental impact of the product

- Discussions and examples: The role of strength of materials in the technical, economic and environmental sustainability of society

- Develop or reconstruct a product from idea to verifiable prototype, charting the product life cycle from an environmental perspective

- Global perspectives on sustainable development
- Methods and strategies for sustainable product development, e.g. life cycle analysis, multi-criteria analysis

YEAR 1				YEAR 2			
Quarter 1	Quarter 2	Quarter 3	Quarter 4	Quarter 1	Quarter 2	Quarter 3	Quarter 4
Introduction to mechanical engineering 7 ECTS		Mechanics: Statics 7,5 ECTS	Strength of materials 7,5 ECTS	Mechanics: Dynamics 7,5 ECTS	Machine elements 7,5 ECTS	Integrated design and manufacturing 7,5 ECTS	
Programming in Matlab 4 ECTS	CAD 4 ECTS					Sustainable product development 4,5 ECTS	Industrial economics 4,5 ECTS
Mathematics: Introductory course 7,5 ECTS	Mathematics: Calculus in a single variable 7,5 ECTS	Mathematics: Linear algebra 7,5 ECTS	Mathematics: Calculus in several variables 7,5 ECTS	Material science 7,5 ECTS	Material & Manufacturing technology 7,5 ECTS	Thermodynamics and energy technology 7,5 ECTS	Industrial production and organisation 6 ECTS

- Calculations and simulations as tools essential for resource-efficient product development

- Making materials choices considering performance, lifecycle load and cost constraints
- Appropriate alternatives for managing product end-of-life issues, including recycling

- Boundary conditions for the society's energy supply and its connection to the climate issue
- Limitations and environmental effects of different energy technologies and fuels, and technology to reduce impact

- Analysing, designing and choosing production systems for efficiency, work motivation, safety and work environment.

Example 2: Mega-projects, Aalborg Universitet (Denmark)



MEGAPROJECTS AT AAU

Megaprojects consist of semester projects. Students from across the whole University contributes with expertise and knowledge from their own disciplinary field in an interdisciplinary collaboration. All megaprojects are based on global problems as formulated in the UN's 17 Sustainable Development Goals.

What do a computer scientist, a business economist and a techno-anthropologist have in common? At AAU, the answer is: a great deal. We know that major problems are often best solved in interaction between different disciplines. We are therefore taking our well-integrated project-oriented and problem-based learning (PBL) to a new level with megaprojects.

MEGAPROJECT: THE CIRCULAR REGION



VISION FOR THE MEGAPROJECTS

The megaprojects aim to provide interdisciplinary solutions to current sustainability and societal issues – in Denmark and the rest of the world. Megaprojects will contribute to solving challenges and problems jointly, at AAU, across campuses, as well as across universities and national borders. By participating in a megaproject, you will:

- Address and work actively with the 17 UN Sustainable Development Goals
- Contribute to solving major issues
- Upgrade your own skills and knowledge through input from other disciplines
- Build up competencies in interdisciplinarity, sustainability and collaboration

MEGAPROJECTS IN BRIEF

A megaproject is an ambitious umbrella project addressing one or more significant societal problems. A megaproject is part of a collaboration with at least one external partner. The megaprojects consists of a number of subprojects all of which contribute to solving the grand challenge set in the megaproject. The students involved are thus working in their own disciplines and as part of their curricular activities.

MEGAPROJECT: SUSTAINABLE LIVING



HOW TO WORK ON A MEGAPROJECT?

The megaprojects serve as an overarching framework. Students work on their semester projects as usual, but participation in a megaproject also involves:

- An online course on the UN Sustainable Development Goals
- Preparation of four smaller deliverables and a concluding joint summary.
- Participation in mid-term and end-term seminars where students working on the same challenge meet to share knowledge and experience.
- Participation in the megaproject conference where the students present the semester's result on the challenges.

The conference also serves as the start-up and basis for the next semester's projects under the megaproject.

Read more about how you as a student can become part of a megaproject

MEGAPROJECT: BETTER TOGETHER



THANK YOU!

Follow the FTS project progress on ntnu.no/fremtidensteknologistudier



Photo: © Kai Dragland/NTNU