Vision on Education 2024-2030

Educating Future-Proof Engineers

Preface

Education is evolving alongside society; having a clear vision on education helps us navigate this constantly changing landscape. This vision on education represents our collective commitment to empowering students to become future-proof engineers while fostering a community where learning thrives.

The context for this vision is both exciting and challenging. Technological advancements, societal demands, political changes, and environmental imperatives require us to embrace new approaches to education. We emphasise that education quality relies on the content and professionalism of educators, as well as the broader organisational aspects. This includes the climate in which students receive their education, the way in which education is facilitated and the care with which it is managed. In our discussions, we champion progressive education and prioritize inclusivity, collaboration across disciplines, and the well-being of our students and staff. In addition, we regard being willing to learn continuously as an intrinsic part of our quality culture and practice.

As we set sail towards a point on the horizon, what we see before us is a journey where the diversity within our engineering programmes serves as the driving force that takes us forward. We emphasise our university's capacity for incremental change. We focus on maintaining our reputation for academic excellence while actively embracing educational innovation and didactic research. The key lies in providing robust support and resources for students and staff, programmes, and faculties to ensure that our educational journey is not just imagined but lived.

We would like to express our gratitude to all who have contributed to the ideas that have informed this vision, whose dedication and expertise were instrumental in its development. As you read this document, we encourage you to engage with these ideas and principles. We hope you will find inspiration and a shared sense of purpose, bringing your creativity and passion to the process ahead.

Tim van der Hagen, Rector Magnificus & President - Executive Board

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Sacha Kroonenberg, Director - Education and Student Affairs

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Introduction

Impact comes in many shapes and sizes, from groundbreaking technology to cultural enrichment and education itself. From political, social, economic, and environmental changes to the intrinsic value that society assigns to knowledge. We are committed to playing an ever-greater part in all these areas, contributing to an inclusive and sustainable society.[1]

Our Vision on Education is built on the foundations of earlier documents on vision and strategy, such as the Vision on Education 2018-2024, the discussions around Teaching and Learning[2] and the Strategic Agenda TU Delft 2024-2030. It also takes into account diverse perspectives from across the university in dialogue and collaboration, with the aim of creating a transparent, and adaptable educational system.

Looking ahead to 2030, the rapid pace of technological innovation impacts not only what we need to teach, but also how we teach. Future engineers will need skills that go beyond technical know-how, such as being mindful of the ethical use of technology, balancing its benefits with potential harm. Our academic staff also need skills that go beyond the traditional. While we place our focus on education, more than ever we are also aware of our duty of care[3] to students and staff in ensuring their wellbeing in a safe and inclusive environment.

With this document we want to provide a clear direction for the development of our programmes, teaching methods, policies, facilities, educational support services and the further professionalisation of academic staff[4] at TU Delft. In the following chapters, we outline the values that guide learning, how and in what context we want our students to learn as well as the role of the community in our education.

> *"Education is not preparation for life; education is life itself."*
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> - John Dewey

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1   *Strategic Agenda TU Delft 2024-2030 - https://www.tudelft.nl/over-tu-delft/strategie*
2   *Vision on teaching and learning_Draft5_2023 11 10 and VoTL_Faculty Feedback_2023 11 10*
3   *TU Delft Duty of Care Memo, 2023*
4   *By academic staff we mean staff with a teaching role, from PhD candidates, Postdocs, assistant, associate, full Professors to full-time Lecturers.*

Values and competencies of the future-proof engineer

State-of-the-art technical knowledge and skills

At the core of our education lies a focus on developing fundamental disciplinary knowledge in science, engineering, design, and advanced technology. At the same time, we adopt an interdisciplinary mindset necessary to tackle complex challenges, stimulating critically thinking and analytically strong engineers. The intrinsic connection between education and research is key to achieving this. In this way we fulfil our aim to continue to play a leading role worldwide in the field of innovative engineering and innovative engineering education.

TU Delft education caters to a variety of profiles to meet both societal needs and individual competencies. Our curriculum focusses on building state-of-the-art knowledge and skills while addressing emerging fields such as energy transitions, climate change and adaptation, resilient living environment, AI, and future of health. We provide students with a comprehensive learning experience that allows them to explore a full range of values and competencies, helping them develop an academic approach and mindset. Through transdisciplinary, multidisciplinary, and interdisciplinary coursework and hands-on research opportunities, students will develop the expertise required to contribute towards societal challenges and prepare them to participate in a global workforce. In relation, we are developing an open and online portfolio that addresses global challenges aligned with the UN Sustainable Development Goals. Furthermore, we support students in engaging with a variety of extracurricular activities - including student associations, study associations, clubs, dream teams and project teams - to enhance their transferable competencies and holistic development.

> TU Delft strives to offer every student education 'with AI' and 'in AI'. By enabling every student to receive AI education, we are working together to build a society that can integrate AI in a responsible and successful manner.

Proactive, responsible, and resilient engineers

Learning to be proactive is underscored by a focus on critical thinking, curiosity, and creativity, enabling students to navigate complex problems and explore new frontiers of knowledge. They learn to demonstrate awareness and autonomy, staying attuned to their learning process and fostering a can-do mentality that prepares them to deal with uncertainties.

Integral to this vision is the notion of responsibility – both in terms of technical proficiency and in understanding the broader implications of one's solutions or actions. Students are encouraged to exhibit humility and respect, recognizing the limitations of their methods and knowledge. By fostering a socially aware and responsible mindset, we aim to nurture reflective engineers who are ethically minded and technically proficient professionals. We educate our engineers to understand the challenges they come across and be able to responsibly intervene and improve.

Personal resilience is another key pillar of the educational ethos, emphasizing the importance of adaptability in the face of challenges. We educate engineers who can lead transformative change towards pioneering solutions. Students are supported in developing a 'growth mindset': learning to view obstacles as a positive opportunity for learning. This resilience[5] enables them to thrive in academically challenging environments and navigate the uncertainties of the future with confidence, bearing in mind their own wellbeing.

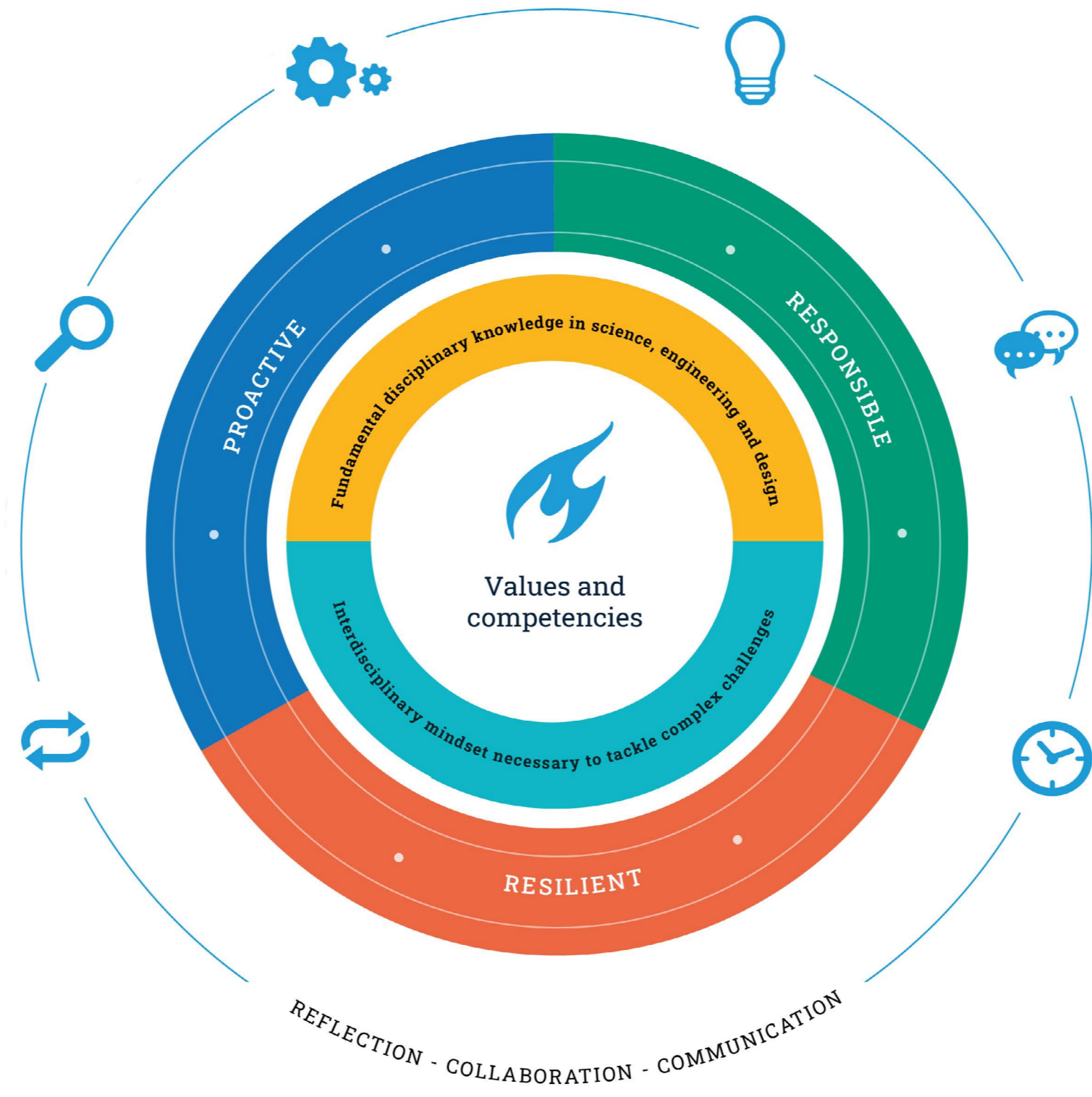## Role of reflection, collaboration, and communication

We aim for meaningful reflection[6] in education where students and educators learn to relate their personal experiences and inner perspectives to the goals and perspectives of other people. That reflection should be put into practice within the technical domain where the application will differ depending on the specific context. Students must be trained by being given hands-on examples in a supportive environment to help them figure things out for themselves.

Collaboration in teams is crucial in our education. By assigning projects that require interdisciplinary teamwork, discussion and knowledge sharing, students can learn not only technical skills, but also effective communication and collaboration—skills vital for engineering practice. Furthermore, engineering often involves complex problem solving with many different stakeholders. This systematic approach to collaboration enriches the learning experience and forges links, essential to the development of both students and educators.

5   Price, R.A., & Bijl Brouwer, M.v.d. (2023) The Resilient Designer's Handbook. Self-Pub. ISBN: 978-94-6366-743-2. URL: https://resilientdesigners.com/

6   Hermsen, P. E. A., van Dommelen, S., Espinosa, P. H., & van den Bogaard, M. E. D. (2023). The Power of Perspective Dialogue: Unlocking Transformative Reflection in Engineering Education (Practice)

2.

PROACTIVE

RESPONSIBLE

RESILIENT

Fundamental disciplinary knowledge in science, engineering and design

Interdisciplinary mindset necessary to tackle complex challenges

Values and competencies

REFLECTION - COLLABORATION - COMMUNICATION

Our approach to education

We envision teaching and learning to be a transformative educational journey that fosters collective development for our students and staff.

Meaningful and adaptive educational experiences

Good education is reciprocal and responsive. It is a relationship, not a transaction. It cannot be fully pre-planned or programmed. There must be room for true interaction where educators and students shape courses in response to, and in co-creation with each other. Our didactic approach is inspired by the idea that education should focus on qualifications as well as socialization (becoming part of societal norms and cultures), and personal development.[7] We seriously consider how to balance all three within and beyond the classroom, in order to create meaningful educational experiences.

We highlight a systems perspective, which addresses societal challenges from a technological as well as a socio-political viewpoint, showing crucial interactions among the different domains of what we teach. We actively engage students in real-world engineering problems, so they learn to develop solutions through direct experiences and experimentation based on their technical foundational knowledge. We connect theory with practice and integrate concepts from various fields to give students an in-depth understanding of such challenges and to emphasise the inter-connectedness of different disciplines. This requires collaboration, which can only flourish in an open academic community that engages with industry, civil society, the public sector, and the natural environment. In this respect, the academic learning environment both anticipates and interacts with the professional working reality that our graduates will enter. We also strive to create a classroom in which students and staff with different nationalities and cultures engage in a diverse learning environment that enables students to gain international and multicultural experiences.

Ownership of learning

We strive to further develop students' own ability to learn.' Our teaching encourages students to connect with the content (active learning) and motivates them to think critically. Educators engage with students' goals and motivations and stimulate them to take responsibility for their own learning. At the same time, they challenge students' goals and motivations to expose them to ideas, values and practices that are different from their own. Both students and educators grow by such interaction that also fosters relationships based on understanding and trust. Our educators guide students, leading by example and equipping them with the competencies, attitudes and techniques that will help them to navigate through uncharted territory.

We enable students to take ownership of their learning and development throughout the educational journey. It is seen in context of the different phases of development, where a first-year bachelor student may need more guidance, and in the later phases' courses and programmes are designed to give students more autonomy. This first year of a bachelor study programme has a selective nature where we implement the binding recommendation on continuation of studies[8] (BSA – 45 ECTS). It serves as a good predictor of whether the programme is a good match for the student and if they are capable of completing it within the nominal study duration.

Assessment

We encourage a wide variety of assessment methods that cover different angles: assessment on learning, assessment for learning, and assessment as learning. We use state-of-the-art assessment tools that are appropriate to the context and needs. Our educators use assessments to see if students are achieving the learning goals set and to keep track of their progress, testing them in a fair and meaningful way.[9]

We recognize that failure is part of the learning process and view assessment as a tool to enhance learning, including low-stakes assessments that allow for development through failure. Risk-taking and innovation should be normalized and rewarded. However, we understand that failing can be difficult due to potential consequences like a negative binding recommendation (BSA), unexpected study delays, extra tuition costs and self-imposed pressure for academic excellence. These challenges highlight the need to manage student expectations and help them accept failure as a crucial step toward progress.

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7   Biesta, G. Good education in an age of measurement: on the need to reconnect with the question of purpose in education. Educ Asse Eval Acc21, 33–46 (2009). https://doi.org/10.1007/s11092-008-9064-9
8   Student Charter 2023-2024, Article 4.9
9   Assessment Framework TU Delft 2023-2028
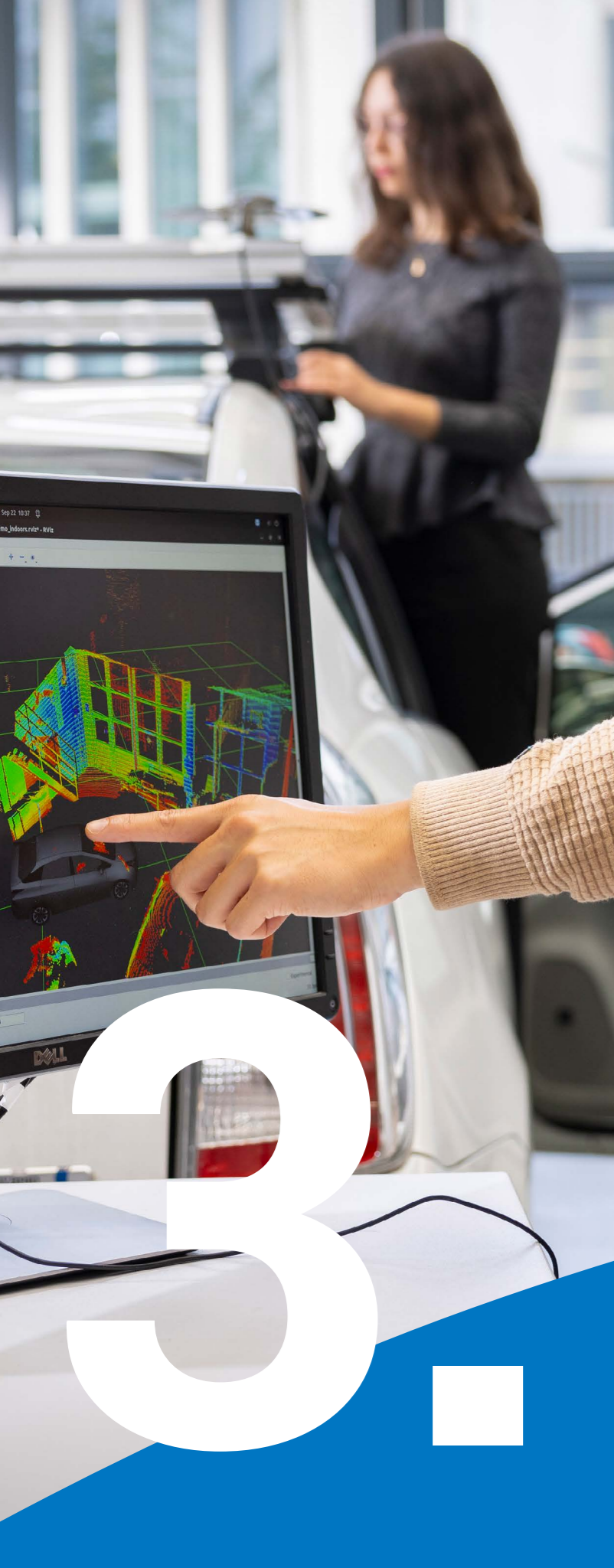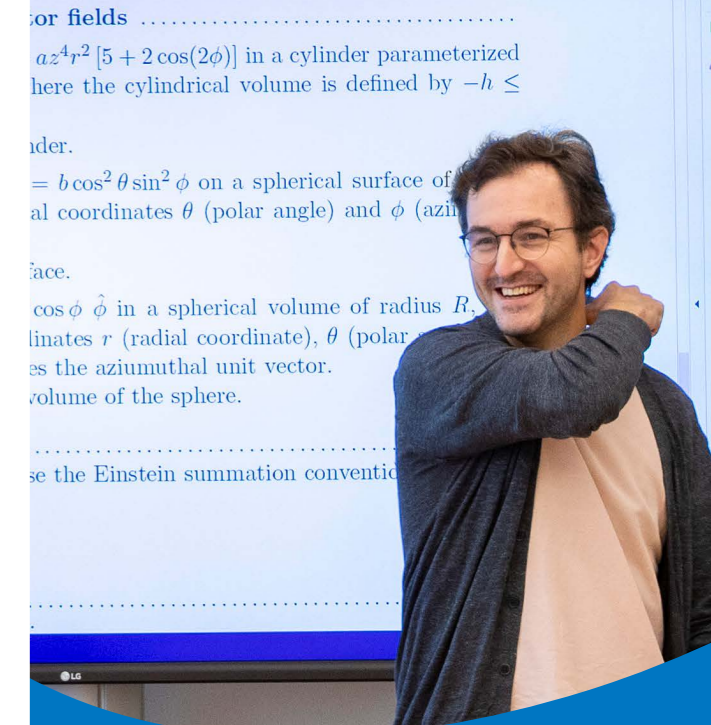
Advancing engineering education through research and innovation

We are dedicated to researching engineering education and continually improving the quality of our education through the implementation of innovative teaching methods. For this, we use empirical educational science as a foundation, and we learn from experiences of the academic community. We are active with our engineering education research, the results of which we will apply in our education as well as provide the corresponding support and training for our educators. We collaborate with other institutions and research funders to assess and continue to improve the quality and impact of education.

The TU Delft Teaching Academy Initiative on Innovation in Delft Engineering Education (IDEE) combines innovation and research to address university-wide educational challenges for a lasting impact on TU Delft Engineering Education.

We are always exploring new ways to enhance our education, whether on-campus, online, or a mix of both. We promote the design and implementation of blended learning; a deliberate, integrated combination of online and face-to-face learning activities.[10] Technology plays a crucial role in how we teach and learn. Our Learning Management System (LMS) is the digital core from which educational tools can be accessed and used, providing an integrated learning environment tailored to the changing requirements of education and in which the learning process is fully supported. Furthermore, to enhance adaptive and tailored learning experiences and to support ownership of learning, we employ state-of-the-art technology such as AI for educational analytics and interaction.

Teaching and Learning Services, established in 2018, is a partner for educational development, improvement and the professionalisation of teaching. They offer effective and accessible services and expertise such as Teaching Support, based on an evidence-informed approach to education, innovation and learning technology.

Societal changes impact our education as they lead to changing demands from practice and practitioners and these in turn, influence the needs of students and educators. These needs we meet by offering programmes with built-in flexibility through a variety of tracks and elective courses. For example, students can take part in minors, bridging programmes, interdisciplinary programmes and projects that include non-technical disciplines. Equally important is taking into consideration both student and educator wellbeing when designing programmes and courses, with attention to work and study load as well as support requirements.

In line with better preparing engineers for societal challenges, the Executive Board has introduced a policy to allocate the fifth quarter (15 EC) of each Master's programme as elective space that has more interdisciplinarity and freedom of choice. Faculties offer a menu of options for students both within their programmes and from other programmes at TU Delft.

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10   *European Maturity Model for Blended Education, W.F. van Valkenburg, W.P. Dijkstra, B. de los Arcos, Delft University of Technology, The Netherlands and Katie Goeman, Veerle van Rompaey, Stephan Poelmans, KU Leuven, Belgium*

The learning context

TU Delft houses a diverse community from around the world, for whom we strive to be a welcoming place of learning. While our community harbours a wide range of expertise, experiences, and aspirations, a common denominator is a shared passion for science, engineering, and design.

Academic learning community

At the heart of our academic learning community, students and staff work together in a spirit of intellectual inquiry and academic pursuit. We recognize and support diverse talents[11] among our academic community, leaving room for exploration, innovation and encouraging continuous learning. Our academic staff play a pivotal role that encompasses shaping teaching practices, developing skills and aligning with programme objectives and societal needs. Also important to this ecosystem of learning is the network of teaching assistants. We support our academic staff, in their research, teaching and supervisory roles, with tailored training, mentorship and peer-to-peer support. We provide opportunities for further development through programmes such as the (Senior) University Teaching Qualification, Recognition and Rewards and Continuous Professional Development activities.

> The Senior University Teaching Qualification (SUTQ, or SKO in Dutch) developing programme provides experienced university teaching staff with the opportunity to develop advanced teaching skills as a part of Continuing Professional Development.

Intrinsic to the academic community are professional facilitating staff who contribute by advising, providing technical support, and balancing faculty needs with available resources. They guide educational choices and offer training on effective practices, introducing new didactic concepts that are beneficial to existing learning techniques. In a collective effort with management, they support students and educators, remove obstacles, and enhance study programme feasibility. Moreover, leadership training for staff involved in education innovation and management is promoted to continually improve teaching quality. Important to the management framework are bodies like the board of studies and board of examiners that comprise academic staff and students alike, who shape and monitor the study programmes.

The Campus

Our campus is the beating heart of TU Delft. Much more than just buildings, it is a place for interaction, collaboration, and co-creation where education, research and innovation inform and reinforce each other.[12] It is a welcoming environment that supports students' personal and professional development and well-being. It serves as a central hub for both academic and social interaction with flexible spaces for project work, co-creation, and group activities. It also fosters collaboration with the city of Delft and its immediate surroundings. The campus plays a big role in stimulating and facilitating academic interaction and connection, fostering open mindedness and the skill of listening. In addition, it serves as a dynamic ecosystem where companies and knowledge institutions come together to innovate and implement modern technologies.

National and International Context

As the demand for engineering graduates grows nationally, TU Delft is committed to educating technical professionals who can drive societal change. The aim is to attract more diverse groups of students, promote collaborations and leverage environments that enrich the content of the academic programmes. To do so, the university will focus on moving outside of Delft, thus relieving some of the pressure on the campus and city. By 2030, we will extend our campuses in The Hague and Amsterdam and establish a new campus in Rotterdam.

Dedicated to removing barriers to learning, we promote open education, open access, and shared online resources[13] to contribute to global education. We offer Lifelong Learning (LLL)[14] opportunities for students and professionals worldwide, keeping in mind that LLL also has a positive impact on initial education. We value collaboration across educational levels, with other universities as well as with institutions for intermediate and higher vocational education (MBO and HBO). We actively maintain academic partnerships such as LDE, 4TU, Convergence and ENHANCE. This ensures a comprehensive approach to learning and knowledge exchange and the sharing of best practices.

> ENHANCE is an alliance of ten European universities of technology with a strong focus on innovation and research. TU Delft leads the Work Package, 'Future Skills for Engineers and Scientists,' which aims to identify and deliver the critical future skills and experience our STEM graduates will need to thrive and remain competitive in a resilient, global, and value-based European Society.

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11 *Room for everyone's educational talent, May 2023*
12 *Campus Vision 2040*
13 *Open Educational Resources Policy 2021*
14 *Lifelong Learning Strategy TU Delft 2023*

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Colophon