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Change to Care

Transforming our Dducation and Focus on Students' Identity Development

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Abstract

At TU Delft, we are not just educating engineers; we are shaping the future of engineering and engineering education. We are empowering our students to become the kind of leaders who can navigate complexity, embrace change, and build a better world, also under VUCA conditions. In this manifesto, we develop a line of reasoning to rethink our education, moving away from 'professional problem solvers' to 'individuals who care for our collective future from an engineering background.' We believe that TU Delft has a unique opportunity to lead the way in reimagining engineering education for the VUCA world. By embracing the principles outlined in this manifesto, we can empower our students to become the future-proof engineers that our society needs. We invite all members of the TU Delft community – faculty, students, and staff – to join us on this exciting journey.

Keywords: Care, engineering education

Introduction

Imagine a world where artificial intelligence outpaces human decision-making, where rising sea levels threaten coastal cities, and where energy demands push our planet to the brink. The challenges we face are unprecedented: technological revolutions, global interconnectedness, social upheavals, and the urgent need to address climate change and biodiversity loss. We live in a VUCA world – volatile, uncertain, complex, and ambiguous – and it demands a new breed of engineer. As Barabási (2011) noted, "an increasing number of the big questions of contemporary science are rooted in the same problem: we hit the limits of reductionism." A technical solution focusing on a single aspect of the problem will not lead to sustainable change. To thrive in our future environment, engineers need more than just technical chops: they must be proactive, adaptable, resilient, responsible, entrepreneurial, and aware of the impact their work has on society and the planet.

At TU Delft, we are not just educating engineers; we are shaping the future of engineering and engineering education. We are empowering our students to become the kind of leaders who can navigate complexity, embrace change, and build a better world, also under VUCA conditions. In this manifesto, we develop a line of reasoning to rethink our education, moving away from 'professional problem solvers' to 'individuals who care for our collective future from an engineering background.'

Changing perspectives from 'concern' to 'care'

TU Delft has a proud legacy of engineering excellence. Our graduates are known for their problem-solving skills and technical expertise. But the problems they are facing are becoming increasingly complex, not just from an engineering perspective, but particularly also from a socio-political perspective. The origins of problems are socially debated, and the solution spaces are highly politicized. In a VUCA world, engineers need to be able to:

- Make critical decisions in the face of uncertainty and constant change
- Be sensitive to both new technologies and other ways of thinking
- Embracing lifelong learning as a necessity to adapt to constant societal change
- Collaborate effectively with people from diverse backgrounds

- Understand the impact of their work on society and the environment
- Develop solutions that benefit humanity and the planet

In an earlier essay in 2004, Bruno Latour (a French philosopher, sociologist, and anthropologist of the 'scientific process') discusses that 'matters of fact' contrast with what he calls 'matters of concern,' offering a nuanced perspective on scientific inquiry and knowledge production.

Matters of fact are understood as discrete, objective, and self-evident truths that can be observed and verified independently of social or cultural context. Matters of concern, by contrast, focus on the broader web of relationships, controversies, and contexts that give rise to facts. They emphasize the dynamic, contested, and situated nature of knowledge. We have acknowledged this also within the TU Delft and, of course, observe problem-based learning, challenge-based learning, design education, and inter- and transdisciplinary pedagogies being used in our educational approaches to familiarize students with these dynamics and social complexity.

But we would advocate to go one step deeper and change the way in which we teach our students to embrace this VUCA world. Not as matters of concern but as 'matters of care.' We follow Maria Puig de la Bellacasa (2017), a philosopher who built on Bruno Latour's concept of matters of concern by introducing a more explicitly ethical and affective dimension. Her work highlights the importance of care (NB, not healthcare, but care in the broadest possible sense) as a way to rethink how we relate to the world and the issues that matter to us.

This shift emphasizes not only recognizing connections and relationships but also taking responsibility for and nurturing those relationships. Furthermore, by calling into question the networks of relationships that condition or constrain our human understanding, we shift away from 'how engineering can contribute to social problem solving,' towards 'how we can respond to and engage with the world in ways that involve care, maintenance, and repair' in the reordering of things (cf. Foucault, 2003) especially in contexts of ecological and social crises. So, not 'care about,' but 'care with' our collective future. And this paradigm shift requires us to also transform the way in which we teach our future engineers, and the starting points from which we do that.

Empowering Students as Agents of Change through Identity Development

From this perspective, we believe that education is not just about acquiring knowledge and skills; it is also about developing a strong sense of self. If we truly move from concern to care, students must find reasons for themselves to want to care for their future rather than just knowing what they could do to care for their future. From this perspective, we cannot just focus on knowledge and skills as part of academic competencies coming from whatever disciplinary, interdisciplinary, or transdisciplinary background. We suggest following Gert Biesta, who identified three key purposes of education: qualification, socialization, and subjectification. Next to qualification, which involves equipping learners with knowledge, competencies and practical skills for societal roles, such as employment, we should also focus on socialization, which focuses on integrating learners into social structures by discussing cultural norms, values and traditions of the university and the larger social environment, and subjectification, which should gain priority in our education systems, emphasizing personal autonomy and critical thinking, helping learners to develop their identity and engage with the world meaningfully.

We believe that subjectification has been largely neglected in our engineering education. An overemphasis on qualification has overshadowed the development of individuality, or at least our potential contribution to or responsibility for students' identity development during their time at our institution. Critical pedagogue Paulo Freire (2005:73) theorizes that 'the more students work at storing the deposits entrusted to them, the less they develop the critical consciousness which would result from their intervention in the world as transformers of that world.' Following his ideas, we are advocating for fostering critical consciousness in our students, help them discover their personal values and aspirations with their engineering pursuits, and inspire them to actively 'care' for and positively impact their environment.

Anticipating and Integrating Future Engineering Competencies

For students to care and to develop their identity, we, teachers, need to stay ahead by co-producing future-oriented engineering competencies into our curricula. And such competency requirements may also develop over time and are not carved in stone. For us, this means that we need to put emphasis on designing agile degree programs that can:

- Identify and integrate future engineering competencies, e.g. by collaborating with societal partners to determine the competencies that will be in demand such as systems thinking, effective communication, digital literacy, computational thinking, negotiation, and persuasion.
- Be modular and flexible, allowing for swift integration of new competencies. Electives and minors in emerging fields like ethics and governance in technology, sustainable energy, AI, and innovation and entrepreneurship to enable students to tailor their education.
- Foster transdisciplinarity and interdisciplinarity, to promote a systems engineering approach to challenges by integrating insights from various fields, including social sciences, business, and humanities. This approach prepares students to address complex, real-world problems.
- Stimulate critical awareness in students, by taking on a dialogue approach in teaching. By fostering dialogue between students and teachers, these interactions encourage the sharing of insights, the challenging of assumptions, and the development of a deeper understanding of the subject matter. The teacher and students become jointly responsible for a process in which they all grow, mediated by constructs or real-world events (Freire, 2005:80). To support this process, students could maintain a portfolio of their work to document their learning journey and reflect on their progress.

By embracing these principles, TU Delft aims to prepare engineers who are technically proficient, responsible, and capable of navigating the VUCA world, respecting and advocating societal stakeholders' viewpoints and interests and able to tackle problems from the systems' perspective. In that world, they learn to make informed decisions, and contribute positively to the care of our society and the environment from their own, individual, moral frameworks, whichever form that may take.

From problem solvers to individuals who care for our future

We believe in the transformative power of learner agency, envisioning a world where students actively shape their own educational journeys. University education, for us, is not merely about the ability to absorb knowledge but about cultivating the "knowing will" – the capacity to apply knowledge meaningfully to make a real difference in the world.

Achieving this vision requires a fundamental shift from a teacher-centric model to a student-centric approach. In this framework, students are empowered to take ownership of their education and develop a strong sense of self, becoming active participants rather than passive recipients in their learning process. This is also in line with our steps towards more inclusive education. Students are important agents to map their levels of competencies and in figuring out what knowledge and competencies they need to become a professional with certain values, knowledge, and skillset, and create their own learning trajectories. To bring this vision to life, we will take several steps.

First, we aim to give students greater choice and control over what they learn and how they learn it, fostering an environment of autonomy and personal responsibility and supporting diversity.

Second, we will create a learning environment that actively encourages exploration, experimentation, and a willingness to take risks, recognizing that innovation often arises from trying, failing, and trying again. Third, we will emphasize self-directed learning, enabling students to pursue their unique interests and passions while staying engaged and motivated.

In addition to this, we will transition our focus from traditional, close-ended problems to open- ended projects that challenge students to think creatively, critically, and collaboratively. This approach equips learners with the tools to tackle real-world complexities while fostering teamwork and adaptability. This also means, moving away from just the 'problem solving' approach that we have so intensely adopted within our institution, and move more towards a more realistic perspective where problems are not merely societal 'speedbumps' for which engineers design and develop coping tactics.

Through open-ended challenge-based learning, students are encouraged to reflect deeply on the societal impact of their engineering solutions, understanding also better the ethical and communal dimensions of their work. By embracing these strategies, we aim to nurture empowered learners who are not only equipped with knowledge but also motivated to apply it for meaningful and lasting change in the world.

Evolving Educators for a Caring Future

The transformative vision we have outlined, shifting from 'problem solvers' to 'individuals who care for our collective future,' demands a parallel evolution in our educators. They are no longer solely knowledge disseminators, they must become architects of transformative learning experiences. This necessitates a pedagogical shift, embracing active learning facilitation, innovative digital and hybrid methods, and

assessment designs that truly gauge complex competencies. Crucially, educators must cultivate strong mentoring and coaching abilities, fostering student identity development through reflective practices and culturally intelligent, inclusive pedagogies. To model lifelong learning and navigate the complexities of a VUCA world, continuous professional growth is paramount, including AI and digital literacy, and the capacity for interdisciplinary collaboration. Moreover, educators must embody leadership, facilitating team dynamics, managing change, and engaging stakeholders to cultivate a learning environment where the principles of care and responsibility are not merely taught, but lived.

Conclusion

We believe that TU Delft has a unique opportunity to lead the way in reimagining engineering education for the VUCA world. By embracing the principles outlined in this manifesto, we can empower our students to become the future-proof engineers that our society needs. We invite all members of the TU Delft community – faculty, students, and staff – to join us on this exciting journey.

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Large Language Models were utilized in certain sections of the text for editing or drafting narrative or argumentative sections that were then carefully checked, reviewed, and/or modified by authors for accuracy and alignment.

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Authors' Biographies

Dr. Steven Flipse is Assistant Professor at TU Delft, focusing on transdisciplinary collaboration and responsible innovation. His research examines how scientists, engineers and designers can integrate diverse viewpoints - spanning societal, economic, and environmental considerations - into their innovation processes. He aims to understand decision-making in inter- and transdisciplinary teams, aiming to promote inclusiveness and ethical reflection in research and development. In his education, he also aims to integrate inter- and transdisciplinary perspectives in his courses.

Thomas Geydan
Drawing on a science background and international education, Thomas Geydan is an educational developer and coach at Delft University of Technology. He specializes in coaching, curriculum design, and bridging academic learning with essential professional skills. Thomas creates innovative educational solutions that empower students and educators, preparing future STEM professionals to thrive in a dynamic world by fostering technical excellence and personal growth to meet evolving economic, social, and environmental challenges.

Marian Bosch-Rekveldt is an Associate Professor in Project Management at the faculty of Civil Engineering and Geosciences, Delft University of Technology. Her research on large infrastructure projects focusses on managing complexity and the development of fit-for-purpose project management to create value by projects. Knowing that people are key, investigating collaboration is one of her key interests. Her passion for education shows in her broad involvement in BSc, MSc and professional education, with her courses revolving around developing broader engineering skills. She is the Director of Studies for the BSc Civil Engineering of TU Delft.

Wenyi Chu is a PhD candidate at Delft University of Technology, researching future engineering skills, with particular attention to transdisciplinary collaboration and emotional competencies. With a background in GIS engineering and educational sciences, Wenyi draws on both industry and academic experience. Prior to starting the PhD, she worked in the Dutch semiconductor sector. Her research is shaped by an interest in how technical education can better prepare students for complex social and professional environments. Wenyi is also engaged in conversations around inclusion and is interested in how different ways of thinking and being can contribute to more process-oriented and intuitive engineering practices.

Hanno van Keulen is an Associate Professor of Science & Engineering Education at the faculty of Applied Sciences, and Director of Studies of the MSc Science Education & Communication, which is also the certificate program for teaching STEM subjects in secondary schools. Hanno's research and educational development projects are on the boundaries of STEM education with literacy, art, and diversity-equity-inclusion, ranging from pre-Kindergarten to the PhD. He received his PhD from Utrecht University on 'Making sense – Simulating research in organic chemistry education'. He is editor-in-chief of the European Journal of STEM Education.

Martijn Leijten is an assistant professor of Organisation and Governance at the faculty of Technology, Policy and Management of Delft University of Technology. He manages and teaches courses on project management, process management and leadership and strategic management and is a member of the Board of Studies of the interfaculty Master's programme Construction Management and Engineering. His research focuses on the management of major complex transitions in infrastructures. He is also involved in educational programmes for practitioners.

Iklim Akay is a systems engineering educator at Space Systems Engineering and coordinator of the Collaborative Design Lab at the Faculty of Aerospace Engineering. While her work in space physics may seem far from systems engineering, it is all about managing uncertainty, whether in space, design, or navigating stakeholder needs in satellite instrumentation. As a core contributor to the NxTGEN project, she helps shape the Dutch Approach to Systems Engineering for the high-tech industry. Deeply engaged in educational innovation through the IDEE community, she envisions engineering education as a living system, thus with systems thinking, through collaboration, and for the (space systems) engineers of tomorrow.

Lisanne Roseboom
As Project Manager of the TU Delft Teaching Academy's Initiative on Innovation in Delft Engineering Education (IDEE), Lisanne Roseboom facilitates a space for educational innovation by organising transdisciplinary collaboration and supporting the project teams working on five institution-wide educational challenges. She has a background in critical pedagogy and youth care, and therefore focuses in her work on process management, systemic work in organisations, shared decision making and co-creation of knowledge and solutions with different stakeholders. Alongside IDEE, Lisanne co-initiated SPiCE, a group of students that integrate student perspectives into educational innovation at TU Delft.

Dr. Eva Kalmar is Assistant Professor at TU Delft, at the Industrial Design Engineering Faculty. She is investigating the dynamics of transdisciplinary collaborations in the context of mission-driven innovation and technology development.
By combining sociology and communication theories with the fields

of team science and creativity, she aims to find ways to facilitate effective and creative team processes for socially inclusive and creative outcomes. She is involved in designing and setting various inter- and transdisciplinary education programmes, focusing on the teamwork and communication competencies of students.

Dr. Jorge Martinez is an Assistant Professor with focus on Education at the Multimedia Computing Group of the Intelligent Systems department of EEMCS faculty in TU Delft. He conducts research on acoustic, audio, speech signal and language processing. He conducts evidence-based, and evidence informed innovation in education, pursuing an education vision that could be described as “emphatic and inclusive scientific education”. A vision that incorporates ways to getting to know and understand better our societal context and ourselves, our students and each other, to give students the long-lasting skills and values they need to cope with the challenges of modern society.

Paul Chan is Professor of Design and Construction Management at Delft University of Technology. He has developed a track record of studying how people cope with organisational, social and technological change in addressing societal and sustainability transitions. He is currently leading research projects on transdisciplinary collaboration in sustainable urban environments. He was Editor-in-Chief of Construction Management and Economics, and Past Chair of the Association of Researchers in Construction Management. He has also written on masculinities and sexualities in the construction industry, and is co-author of Constructing Futures (2010), a Wiley-Blackwell book on leadership and futures thinking in the construction industry.

Dr. Hanieh Khodaei is Assistant Professor at the faculty of Technology, Policy and Management of Delft University of Technology, focusing on Technology Entrepreneurship and Innovation. Her expertise is with technology-based entrepreneurship, the team entrepreneurial behavior and business modelling. Her research contributes to the emerging research field of Technology Entrepreneurship and translate new development in research into education for entrepreneurial mindset engineers. Her research and projects build towards a curriculum that can improve entrepreneurship education for engineers.

Comments by authors

on the process of writing this manifesto:

It was a collective effort of the TU Delft Innovation in Delft Engineering Education team on Future Engineering Skills. We enjoyed the process very much.

on the received comments:

We are very grateful for the feedback we received. The input is very much appreciated.

The topic is relevant in relation to current scenarios. Having this thought of transforming the education focus towards more societal and communal dimension would produce sensible engineers/humans for the future.

Comments by

Ganesh Umkansar