# innovation Space

## from dream to demo

**TU/e**

TU/e has made an impressive educational transition aimed at training future engineers, through the implementation of the Bachelor College in 2012 and the Graduate School in 2013. The development of TU/e innovation Space was a next step that started at the end of 2015 as a small pilot to strengthen authentic and interdisciplinary learning and to increase the focus on entrepreneurship and engineering design. TU/e innovation Space developed towards **Center of expertise for Challenge-Based Learning (CBL) and student entrepreneurship at TU/e**, a **learning hub for innovation of education**, and an **open community** where students, researchers, industry, and societal organizations can exchange knowledge and develop responsible solutions to real-world challenges. TU/e innovation Space has a growing impact on students, staff, and TU/e. The innovative way of learning is offered to more and more students through an increasing number of courses and extra-curricular activities, and evidence-based research yields first results. Also, the first pilots at the curriculum level are starting.

Now is the time to further develop key characteristics of Challenge-Based Learning and to enable education innovation at university level. In order to achieve the goals of TU/e education in 2030, we propose three projects in total, one project on **competence development (A)**, one on l**earning in the innovation hub (B)**, and one project on **university of the future (C)**.

For spending the money of the Higher Education Award, we defined the following guiding principles for choosing the projects, in line with the goals of the Higher Education Award, namely projects that contribute to the innovation and/or improvement of higher education:

- Experiments and evidence-based research towards education vision 2030, with the aim to improve the learning of students.

- High end goals and area's that really make a difference in relation to what we did, do and plan, to add extra value.

- Safeguarding that funds do not get blurred or mixed.
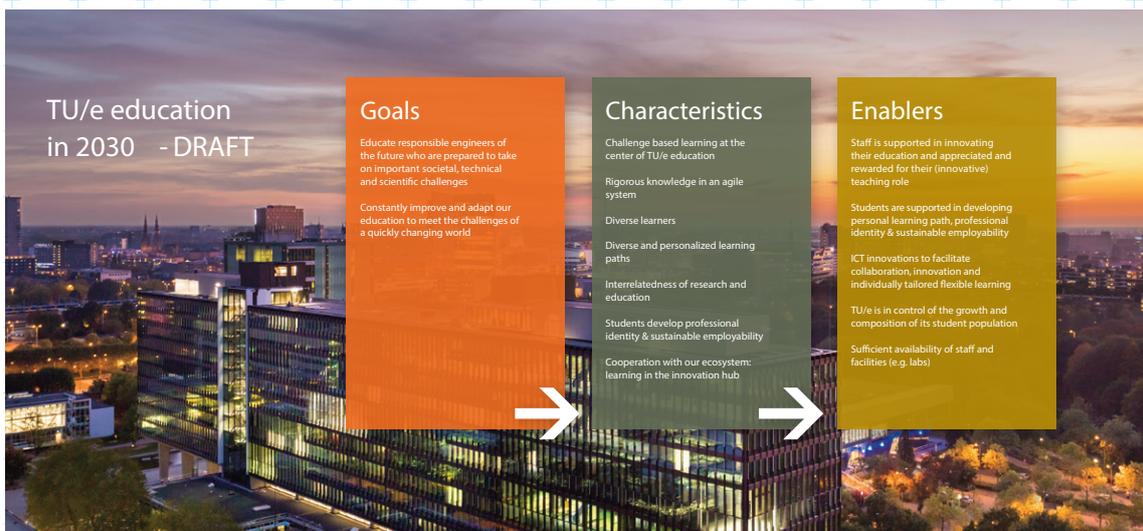


TU/e education 2030 - drivers of change (TU/e, 2020)

The projects on competence development (A) and learning in the innovation hub (B) connect to several characteristics of TU/e education in 2030, and the project on university of the future (C) aims to enable the education vision for 2030:

A. Competence development:
- CBL.
- Diverse and personalized learning paths.
- Students develop professional identity and sustainable employability.

B. Learning in the innovation hub:
- Rigorous knowledge in an agile system.
- Interrelatedness of research and education.
- Diverse learners.
- Students develop professional identity and sustainable employability.
- Cooperation with our ecosystem.

C. University of the future:
- Rigorous knowledge in an agile system.
- Interrelatedness of research and education.
- Cooperation with our ecosystem.

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# A. Competence development

## Why?

CBL requires self-directed and competence-centered learning. In order to be able to support the competence development of students, an overview is necessary of possible competences that students can/should develop, a coaching/mentoring system, and a system to track students' progress (by students and mentors). It requires competence-centered teaching and learning activities, and related assessment. Competences encompass here e.g. entrepreneurial mindset, interdisciplinary collaboration, prototyping, sustainability, and art-related competences, but also specific disciplinary competences, and the possibility for students to define competences themselves. All competences can be attained at beginner, intermediate and advanced level. Self-directed learning and competence-centered learning are also closely linked to students' reflecting on their development of a professional identity and vision, which should also be stimulated, with a holistic focus.

For the Industrial Design (ID) bachelor and master program, the learning outcomes are defined in terms of competences and a pilot will start to develop a system to track students' progress on competence development. We propose a project that starts to make this possible for students from other programs and in an interdisciplinary context. Where relevant, we will learn from the developments having already taken place in universities of applied sciences.

## How?

We propose to:

- Determine an **overview of competences** in three different contexts (pilot personal development as part of Bachelor program; interdisciplinary Master Programs[1] ; and extra-curricular activities of student teams and start-ups) and create insight in **what type of factors influence which competences students can develop, at which level**. E.g. what type of challenges are necessary for the development of certain competences, and how to support students to become self-directed learners.

- Co-develop a **system to track competence development**: support students in documenting their competence development through a portfolio and reflecting on their development of a professional identity and vision by providing insight into (feedback on) courses and projects. We will collaborate with the ID pilot and add additional requirements related to our 3 contexts. Development and IT costs of the system can be part of the ID development and might require additional Boost investments for which we can apply through the regular annual universities' budget for IT innovation for education.

- Enable coaches and assessors to formatively (at intermediate challenges) and summatively (at examinations) **assess** the student's competence development throughout the program.

- Create a personal **coaching system**, in order to have coaches available that are also trained to support competence development of different target groups of students (early interdisciplinary bachelor program, master program, extra-curricular projects). We can think of developing 'a teacher to coach training program' (part of teacher capacity building program) and organize access to experienced alumni coaches.

## Who?

- Senior educational designer (1 fte) 4 years (project lead Project A).

- Co-finance Ph.D. student entrepreneurial learning (10k€/year via 4TU.CEE, still 20k€/year necessary), in a project that will analyze broad entrepreneurial competences.

- Expert in (digital) information and communication technologies, who will help in defining requirements and pilots related to the supporting IT systems, and more in general will develop our expertise and strategy in digitalization for education (partially funded from this project).

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[1] For example Sustainable Energy Transition (SET) program, and possibly extend to Honors Master Program (HMP) and the Interdisciplinary programs Automotive Technology (AT), Embedded Systems (ES), Construction Management & Engineering (CME), Science Education & Communication (SEC), Systems & Control (SC), and Science and Technology of Nuclear Funsion (NF).

# B. Learning in the innovation hub

## Why?

In this project, the strong collaboration of TU/e with partners in its ecosystem will be further developed for education. The growth of Challenge-Based Learning requires to intensify the collaboration because more challenges will be necessary and less ad hoc. Therefore, longer-term partnerships are needed. An increased collaboration can also make TU/e more accessible for employees from industry who wish to update and deepen their competences (professional education/life-long learning).

## How?

We propose to support the creation of thematic ecosystems, e.g. an ecosystem on sustainable energy, with citizens, government, companies and cross-disciplinary research groups at TU/e and other institutes, collaborating in challenges with students and professional education. In essence this asks for connecting a network of external partners via strategic partnerships to interdisciplinary research of academic staff (of institutes, programs, large projects). This makes it possible to offer students a series of challenges on the same theme, with students of different levels (vertical learning: Bachelor, Master, PdEng and Ph.D. students mixed). Additionally, we will be able to have a stable offer of challenges because of longer term partnerships, and to intensify collaborations with other institutes of higher education (local, national and international).

The project will consist of 3 sub-projects:
- Set up a **pilot** to extend one or more of current TU/e practices towards an 'ideal' thematic ecosystem. This requires:

  - **To learn from best practices** of thematic ecosystems available on campus (e.g. ID squads, ILI program, honors bachelors tracks, Engine).

  - To describe **'ideal' type thematic ecosystems** (can be several), based on literature, benchmarks outside TU/e, and co-creation sessions with TU/e practices.

  - A structure for setting up a series of challenges (thematic learning lines, including challenges and disciplinary competences), a structure for vertical learning, longer-term partnerships, and a structure for professionals to join in the challenges. Learn about added value for all involved stakeholders and how to solve obstacles.

- Extend the current **Art & Design ecosystem**, which is very strong in Eindhoven, to TU/e education, in collaboration with all other knowledge institutes in the region (e.g. Design Academy, Sint Lucas, Fontys). This is a start to transform our education from STEM (science, technology, engineering and maths education) to STEAM, i.e. by integrating the Arts (humanities, language arts, dance, drama, music, visual arts, design and new media) into STEM and create real transdisciplinary collaborations. We propose to start with a pilot of a new elective course with Art & Design challenges that are addressed by interdisciplinary teams of students.

- Create a **community of practice** for all thematic ecosystems related to education on campus, to learn from each other and strengthen each other.

## Who?

- Postdoc 3 years (1 fte) (project lead project B).

- Coordinator course on art challenges 3 years (0,1 fte).

# C. University of the Future

## Why?

The central role of knowledge creation in post-industrial economies and societies has given universities the role of orchestrating multi-actor innovation networks[2]. Universities are an increasingly important player in innovation and entrepreneurial ecosystems. However, the structure of the university is not adapted to this new role. In order to realize strategic partnerships with external parties, and being able to innovate within the university, the university also has to perform internal institutional transformations. How can we combine the traditional roles of educating students and developing research while also exploring new roles, education models and business models?

## How?

Research new structures and business models to transform our institutional structure for supporting educational innovation in its innovation and entrepreneurial ecosystems. We can apply and further develop concepts within innovation management, like developing an ambidextrous organization that focuses on its current activities but also creates explicitly room for innovating; or using concepts such as innovators and early adopters, the implementation of organizational change, or other concepts.

We aim to answer the following research questions:

- How to **innovate in universities** and as a university? How to support innovation processes in a university? How to transform a university, guided by themes such as agility and adaptability, dealing with budgetary constraints, faculty issues, local issues, and socio-economic considerations (Graham, 2018)[3]?

- How to explore new roles and exploit the traditional roles of educating students and developing research simultaneously? Or in other words, how to optimize the core business of the university, but also explore **new education models**?

- How can universities create value, deliver value and capture value? What are **new business models** for higher education (EY, 2018)[4] that put the student and on-campus experience central?

## Who?

- Ph.D. student (in collaboration with ITEM, Chair Isabelle Reymen Design of innovation Ecosystems and Dean Bachelor College Ines Lopez Arteaga) (Isabelle Reymen and Ines Lopez Arteaga project leads Project C).

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[2] https://eua.eu/resources/publications/819:the-role-of-universities-in-regional-innovation-ecosystems.html.
[3] Graham, R. (2018). The Global State of the Art in Engineering Education. Massachusetts Institute of Technology (MIT), Cambridge, MA.
[4] EY (2018) Can the universities of today lead learning for tomorrow? The University of the Future.

# Concluding

These three projects contribute to further developing key characteristics of Challenge-Based Learning, and to enabling education innovation at university level. The deliverables of these projects will be evidence-based recommendations on:

- How to roll out competence development on campus.

- How to create sustainable thematic ecosystems linked to education and a community of practice for all thematic ecosystems.

- New education models and new business models for a campus-based university of the future connected with its ecosystem.

Together, they help to achieve the goals of TU/e education vision 2030. TU/e innovation Space will take the lead in these projects, connect them to each other and to many other projects currently being implemented or planned at TU/e, as indicated in Appendix 1. The central position of TU/e innovation Space will also be used for rapidly implementing and upscaling the results at TU/e, and for disseminating resulting evidence-based practices towards other higher education institutes, thereby contributing to the innovation and improvement of higher education in The Netherlands and abroad. The distribution of the Higher Education Award over the different projects is listed in the budget in Appendix 2. We plan for a program leader (0,4 fte) to manage the combination of projects.

# Appendix 1:

## Relation of the proposed projects with other projects currently being implemented or planned

In general, the 3 projects relate to several projects of the TU/e CBL program and BOOST education innovation program. Some examples are given below.

**A. Competence development:**
- projects of CBL program (innovation projects at Industrial Design, USE learning line Toschi, E3 program), Learning analytics projects (Comenius Senior Fellowship Mark Bentum; Project Ines Lopez Arteaga).
- Student employability chain (with My Future, micro-credentials).
- 4TU.CEE Entrepreneurial engineer.
- Interdisciplinary master thesis.
- TU/e Ph.D. Competence Profile.
- TGD sustainability competence framework.

**B. Learning in the innovation hub:**
- Innovation Project 'Strengthening research in education'.
- BOOST project 'Enabling students to interact with living lab facilities and their innovation ecosystem'.
- EWUU.Education U-Collaborate.
- EWUU.Impact on ecosystems.

**C. For University of the future:**
- Ph.D. Project Marisol Velasco Montanez.

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# Appendix 2:

## Budget Higher Education Award TU/e innovation Space 2021-2025

|  | 2021 | 2022 | 2023 | 2024 | 2025 | TOTAL |
|---|---|---|---|---|---|---|
| Competence development | 40 | 135 | 135 | 135 | 60 | 505 |
| Learning in the innovation hub | 20 | 92 | 92 | 72 | 10 | 286 |
| University of the future | 20 | 70 | 70 | 70 | 50 | 280 |
| Program leader | 8 | 32 | 32 | 32 | 25 | 129 |
| **TOTAL** |  |  |  |  |  | **€ 1200 k** |
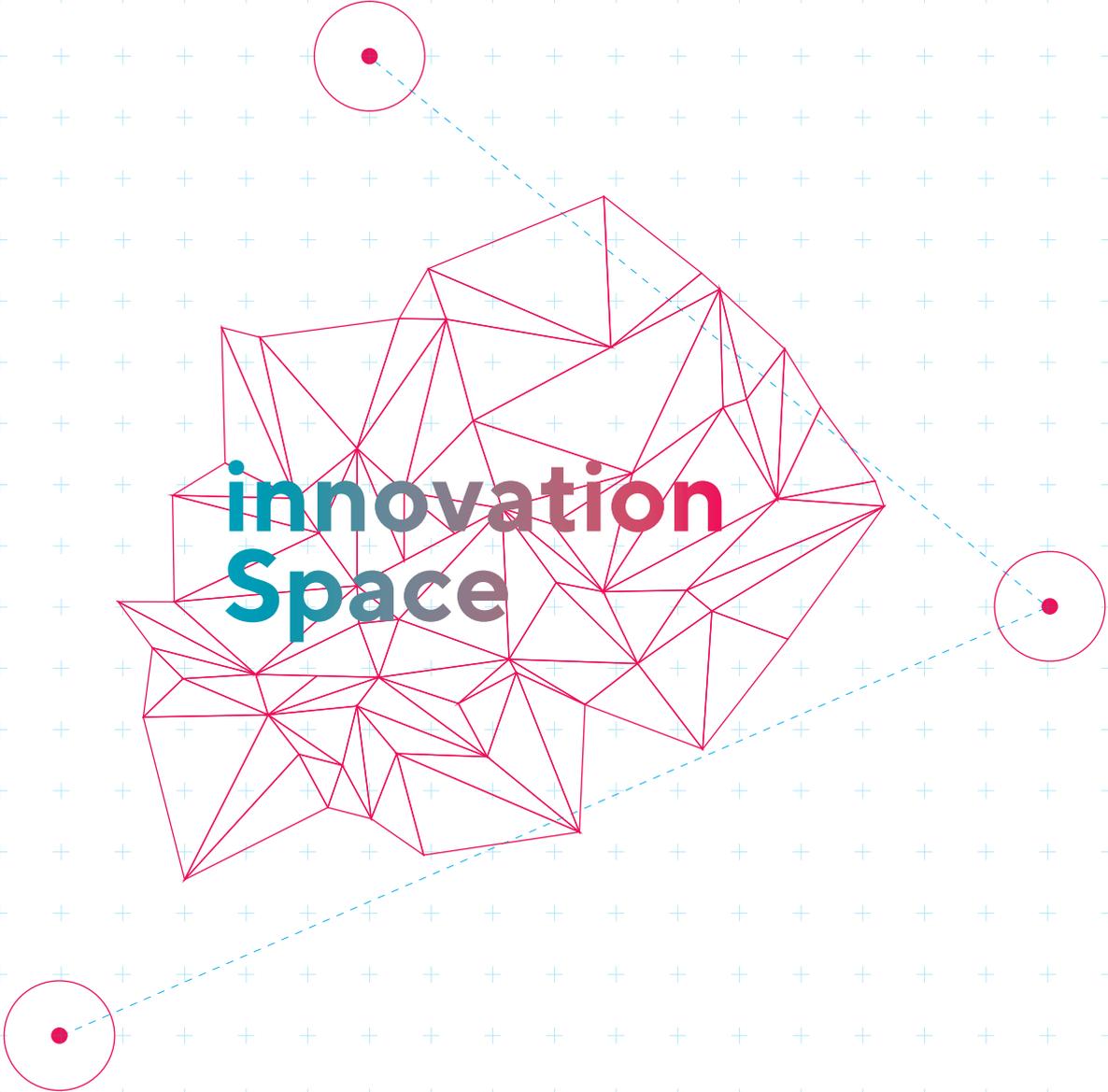
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## Team Higher Education Award:

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|---|---|
| Prof.dr.ir. Isabelle Reymen | Scientific Director TU/e innovation Space |
| Dr.ir. Miguel Bruns | Educational Director Industrial Design, Associate Professor |
| Prof.dr.ir. Rick de Lange | Mechanical Engineering |
| Ir. Suzanne Jacobs | Teacher Supporter |
| Ir. Akos Wetters | First Hybrid Teacher at TU/e innovation Space & TU/e |
| Lenny Apon | Educational Coordinator |
| Dr.ir. Ana Valencia | Educational Postdoctoral Researcher |
| Bart Koppelmans | Student Assistent: student & entrepreneurship |
| Prof.dr. Jan Vermunt | Expert Educational Research |
| Chantal Brans, M.Sc. | Educational Policy Advisor |

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