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TAKING THE INITIATIVE FOR INNOVATION IN ENGINEERING EDUCATION – LAUNCHING THE IDEE MODEL

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ABSTRACT

The Initiative for Innovation in Engineering Education, IDEE, is a university-wide activity at Delft University of Technology (TU Delft), aiming to strengthen the capacity for evidence-based innovation in engineering education. The goal is to create a more systematic and evidence-informed approach to educational innovation at TU Delft, and to ensure that the knowledge gained is documented and shared with the wider education community. This paper describes the first steps in establishing the structures for the initiative, identifying the educational themes to be addressed, mobilising teams of faculty members and recruiting junior researchers, creating support for these teams, and building a productive community. Through this setup, IDEE has high ambitions for creating both educational innovation and associated

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scientific gains. It is also intended to create role models for novel kinds of academic careers with an emphasis on teaching.

1 INTRODUCTION

1.1 Engineering Education Innovation and Research as Strategic Goals

Delft University of Technology (TU Delft) is committed to innovation and research in engineering education, as evident in its Strategic Framework (TU Delft Strategic Framework, 2020-2024; Strategic Agenda 2024-2030). The strategic goals are to further strengthen the connection between research and education by supporting research into education and learning, and fostering a culture of evidence-based innovation and experimentation in teaching and learning. To reach these goals, the university needs a structured way of driving innovation in education to address challenges in education, in a scientific and timely manner. It is important that the knowledge gained can be preserved and implemented by the wider education community, in the education at TU Delft as well as globally.

For this purpose, the university has launched the *Initiative on Innovation in Delft Engineering Education*, IDEE. The term innovation is consciously chosen as it does not just refer to producing novel ideas per se, but to making a meaningful impact through the implementation of new practices in education. Within this initiative, scientific staff members from across the faculties work in teams, with each team addressing an educational challenge, called a *theme*. Themes should represent issues of broad relevance to the university and to engineering education in general.

1.2 Comparable initiative as inspiration

Comparable initiatives can be found at EPFL in Switzerland and Utrecht University in the Netherlands. At EPFL, the Center for Learning Sciences, LEARN, is a collaboration between researchers, practitioners and policy-makers in the field of education. It aims to continuously improve education by designing solutions informed by the state-of-the-art, and empirically evaluating the impact of their implementation (EPFL, n.d.). The 'Senior Fellow Programme' at Utrecht University (Utrecht University, n.d.) aims to strengthen educational leadership within the university and to increase the number of professors with a special focus on education. The programme contributes to the visible appreciation for education and teaching and demonstrates that also a full professor career in education is possible. The programme also aims to promote innovation in teaching and learning and to increase the overall quality of education. Senior Fellows are intended to play a key role in improvements of the education at the university and be an inspiration to their colleagues (Crone et al., 2023).

When creating IDEE, these role models were adapted for the context of TU Delft. This concerned the way the educational challenges were prioritised by many stakeholders, operating in teams to tackle the challenges (as opposed to single scientists innovating or addressing research questions from a specific course), the expectations of the career path (enabling advancement in careers on all levels rather than a specific track to full professorship), adding junior researchers to the teams, and focusing on Engineering Education Research and Innovation for TU Delft and the wider community.

1.3 Combining research and innovation to create institutional change

The design of IDEE was guided by some principles to ensure that the teams can create impact. Firstly, the teams should work on a coherent set of university-wide educational challenges, or themes. This is based on the recognition that in a complex environment like higher education an organization requires simultaneous and sustained interventions to gain momentum for changing practices (see for instance Luisiani & Langley, 2019, cited by Schophuizen et al., 2022). By choosing coherent challenges that are widely supported by both upper management and the education community at TU Delft, IDEE ensures a collective sense of responsibility to create educational change on an institutional level.

Secondly, the challenges are tackled by teams. When individual educators innovate in their courses and programs, impact is often limited to a single faculty, or even department. The IDEE teams are interdisciplinary in nature as they consist of scientific members from different faculties, mostly with an engineering background. To strengthen the capacity for educational innovation, each team hires a PhD and two postdocs, with stronger educational background. To include student perspectives, the teams will also involve students in different ways, for instance via surveys, student councils, freelance student project employees, and teaching assistants. This is underpinned by the idea that co-creation between students and faculty staff not only leads to greater value for output, but may also result in greater value to the individuals who are participating (Dollinger & Lodge, 2019).

Thirdly, research shows that when educators make changes in their teaching practices, they can't always identify if the changes are made based on scientifically sound principles (Kottmann, Schildkamp & van der Meulen, 2023). Therefore, IDEE intends to build bridges between ongoing innovative practices and research, making the underlying scientific principles considered and explicit. A close relationship between educators' practice and educational research offers opportunities to understand the complex process of educational innovation and consider educators' and students' needs. The ideal is to combine the innovations and research in an iterative process. Within the IDEE themes, challenges are discovered, and possible solutions are identified within existing practices or designed based on literature. This process then continues with testing, evaluating, and re-developing. Research shows that a design-based research approach has the potential to promote and facilitate context-sensitive interventions that address issues recognized as relevant by the participants (Tinoca et al., 2022).

Finally, IDEE creates a space for educators to showcase their innovative practices, finding interesting practices of peers and sharing their lessons learned. By bringing their practices into the research being done within IDEE, it creates evidence of faculty teaching competence while also offering a way to strengthen it further.

1.4 Recognition and Rewards in the Dutch Context

IDEE should also be understood in the light of an important shift on the national level, as the Netherlands is currently going through a renegotiation of the academic career system. In the new system for recognition and rewards, less emphasis is given to quantitative measures of research output, such as number of publications and h-index. To enable more diversity in academic career paths, people can have profiles with different balance between education, research, valorisation and leadership (Recognition and Rewards, 2019).

This new career system is already in place, but it is early days and there is still a need to fully make sense of the implications. In this context, IDEE should be seen as a way for TU Delft to manifest the recognition and appreciation of quality of education. Through their engagement in IDEE, numerous people will have the opportunity to strengthen their educational expertise and build up a merit portfolio of scholarly educational innovation. Especially, because IDEE is funded by the strategic funds of TU Delft, it offers educators a first stepping stone into the field even if they do not have a prior record in educational research. Accordingly, IDEE aims to be a productive breeding ground for role models with an emphasis on education, exemplifying new kinds of legitimate and fully recognised and respected career profiles (Crone et al., 2023; Graham, 2018).

2 THE BASIC SETUP OF IDEE

2.1 Teams and Themes

IDEE is designed to offer opportunities for teams of scientific staff members to work on educational challenges. Each team consists of several educators, with a PhD student, two post-docs (one after the other) and an educational developer. While faculty members stay embedded in their respective departments, the teams will also partially work together to inspire each other and share experiences and knowledge. The aim is to have up to five teams working each on a different educational theme at any given time, with each team having five years to research, experiment, evaluate, implement and disseminate their educational innovations.

The themes to be addressed in IDEE are chosen to be relevant and highly interesting for engineering educators, not only strategically important across the faculties of TU Delft but also generally in the engineering education community. To prioritise between potential themes, the following five principles were applied:

  I.   The theme addresses an educational challenge.
  II.   The theme relates to TU Delft degree programmes.
  III. The theme concerns TU Delft as a whole and is, or is expected to become, relevant to most faculties.
  IV.   The goal is to improve engineering education at TU Delft.
  V.   Developed innovations must be applicable to the TU Delft campus and preferably beyond.

The first three themes were formulated in consultation with a group of stakeholders consisting of program directors, representatives of 4TU[*], policymakers, managers within the Department of Education and Student Affairs, and the vice-president of Education. The resulting themes were *Students taking responsibility for their own learning process*; *Retention of knowledge and skills*; and *Future engineering skills*. They are each described in more detail in Section 4 below.

2.2 Mobilising Teams Around the First Themes

During spring 2023, the three themes were announced in an open call to attract educators across the university. The open call ensures an intrinsic motivation of the educator joining the initiative, which is a strong determinant of teachers' commitment

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[*] 4TU is the federation of the four technical universities in the Netherlands, see: www.4tu.nl

to education innovation (Kottmann, Schildkamp & van der Meulen, 2023). In total about 60 educators submitted letters of interest, indicating their chosen theme, and elaborating on the roles that they were willing to take. The participation was not limited and the result was three large groups of faculty members mobilising as teams to formulate a project proposal for the work.

The three teams received a go-ahead in September 2023 and started recruiting the PhD candidate and their first post-doc. This required them to identify who, out of their numerous faculty members, would be the supervisors and promotors, and they also had to select a place in the organisation that the student and postdoc would formally belong to. The first three vacancies were advertised in December 2023 and attracted in total 190 applications. At the time of writing, the first few PhD candidates and postdocs have accepted their offers of employment and candidates for additional positions are being interviewed.

2.3 The Next Round of Themes

IDEE is designed to have up to five teams working at any given time. During 2024, two additional themes are being formulated, and new teams will be created around them. The process starts again with formulating themes that are currently relevant in the field, and specifically at TU Delft, involving the same stakeholders as in the previous consultation session. After the open call, the project managers will organize a number of sessions in which the teams collaboratively work towards a project proposal. In the first round in 2023, this part of the process was left unstructured and up to each team to organise themselves. This was difficult for them especially because the teams were very large and the challenge new. This time, therefore, a somewhat more structured approach will be adopted to provide the teams with more guidance. The sessions will support the teams in getting to know each other as teammates, connecting to IDEE as a program, exploring the theme with educators, students, educational experts and policy makers, identifying problems and opportunities within it, choosing a focus for the project, and defining the mode of collaboration as a team.

3 ORGANISATION AND PROCESSES

3.1 Funding and Support Organisation

IDEE is one of the activities of the Teaching Academy (TA), a network for and by educators of TU Delft with the mission to collaboratively enhance engineering education and drive education innovations across the faculties of the university. Through the TA, each IDEE team is funded for five years, covering the cost for a PhD student, two consecutive postdoc positions (of two years each), and a learning designer (on 20%). In addition, the faculty members are expected to spend 20% of their time, as part of their regular research time.

IDEE is also supported by two project managers (one is the third author), in total 1,4 full-time equivalent. The project managers support the teams by overseeing the overall processes, connecting different stakeholders, facilitating collaboration among the teams, organising events and supporting day-to-day activities of the teams. The project managers collaborate with the Academic Director of the TA (the first author), specifically in positioning IDEE within the university context, and with the Scientific

Expert to create a supportive work environment for the PhD's and Postdocs and guide the teams in the educational research field.

A Scientific Expert in Engineering Education (the second author) was recruited in a part-time (20%) position as Professor in Engineering Education Innovation from 2024. The role is to support the IDEE community in their work, with an eye to furthering the quality and impact of the educational innovations, the quality and impact of the scholarly contributions, and the development of all the people involved – not least the PhD students and post-docs.

The IDEE Board is responsible for strategic management. It consists of the Vice President for Education, the Strategic Policy Advisor for Education, the Academic Director of the TA, and the Scientific Expert of IDEE.

3.2 Enhancing Competence

Team members are offered a program to develop themselves in the area of innovation and change. The aim is to strengthen their capacity for combining innovation and research activities that impact engineering education university-wide. The topics addressed are, for example, transdisciplinary team work, engineering education scientific methods, peer consultation, innovation methods, co-creation sessions and valorisation strategies (Crone et al., 2023; Kottmann, Schildkamp & van der Meulen, 2023).

3.3 Forming a Community

IDEE will organize events where the broader TU Delft education community comes together to learn about the projects, new developments, experiments, innovations, to seek inspiration for addressing their own educational challenges. The objective is to work together and find synergy with other educational innovation and research activities at the university, as well as collaborations on the national level such as the 4TU.Center for Engineering Education (4TU.CEE, n.d.). IDEE also aims to become an attractive environment for scholarly exchanges with international partners. International networks such as SEFI is a natural place to find interesting and interested friends, allies, and partners.

To support the community building, IDEE and its teams have a virtual presence. One part of the Teaching Academy's portfolio is also the Teaching Lab, which is a physical space on campus suitable for hosting large and small meetings, events, and incoming visits. Such activities are intended to strengthen the relationships across the community. Some would be led by internal participants and focus on the work in the teams. Others will feature external experts to discuss subjects of joint interest to the themes. Some events will be more widely open, to enhance the visibility of IDEE, internally, nationally and internationally.

The PhD candidates and post-docs are a key group within IDEE. In addition to the wider aiming workshops and seminars mentioned above, there will be an ongoing seminar to directly support the junior researchers as a group, also with activities such as study trips and joint conference participation.

4 INTRODUCING THE FIRST THREE THEMES

Based on the proposals as written by each team, the first three themes are here introduced, starting with a brief description, some possible questions to be addressed and mentioning some of the planned output. For full descriptions, see the website where each theme has a section (IDEE, n.d.).

4.1 Theme: "Students taking responsibility for their own learning process"

"Taking responsibility and acting autonomously are key competencies for professional engineers and their future contribution to society. They also play an important role in stimulating intrinsic motivation. In this theme, the main question is how to create the conditions to have students take the responsibility for their own learning process. These conditions apply to students, lecturers, the curriculum as well as the learning environment in which they operate."

- What do students need to be able to take responsibility?
- How to design a curriculum which allows students to take responsibility?
- What should lecturers do to stimulate and enable students to take responsibility?"

Some of the outputs that are expected in this theme is a *Glossary of Common Ground* that includes the shared approaches, concepts, and mindsets on the theme, and resources for addressing the issues through a *Pedagogical Pattern Language* (Laurillard, 2012) for pedagogies that foster student responsibility.

4.2 Theme: "Engineering students' progression and retention of knowledge and skills"

"The design and implementation of a seamless continuum of education should take place at all levels: as a learning activity in a single course, as a connection between multiple courses in a single program, with teachers and learners being part of a local teaching and learning culture."

- How to design a consistent curriculum to stimulate progression, retention and transfer of knowledge and skills?
- How to teach new concepts to foster students' understandings of this knowledge with a view on progression ("forward teaching")?
- How to support students in transfer of their knowledge and skills to new settings and applications?

This theme will be addressed through design-based research. Some of the expected result will be principles for curriculum and course design to promote progression, retention and transfer.

4.3 Theme: "Future engineering skills"

"Courses on engineering skills are part of many engineering education programmes. In a rapidly developing society, required engineering skills change quickly. One of the challenges is to better anticipate engineering skills needed in the future and to stay updated on the state-of-the-art engineering skills needed in society."

- How to design agile degree programmes in which future engineering skills are effectively acquired and seamlessly integrated?
- How to make sure that the skills addressed in the programmes are in line with the skills needed?

- How to stimulate critical reflection among students on the application of new engineering skills in professional practice and society?

Some output that is expected in this theme is an *Inventory of transdisciplinary teaching and learning* that is already practised at the university, a *List of desirable skills* with a *Stakeholder analysis*. Later stages, the team formulates and pilots *Design principles for future course development and for program development*.

5 DISCUSSION

5.1 Combining Innovation and Research

The aim of IDEE is to further meaningful *combinations* of innovation and research. The intention is to support a scholarly approach to innovation, meaning systematic rather than ad hoc interventions. The experiences of educational experimentation are intended to contribute to the engineering education research field. In other words, the work should be evidence-informed as well as evidence-producing. One potential research approach is to use a design-based cycle to test, evaluate, redesign and adapt solutions. Documentation and scholarly communication of the experiences plays an important role not only for spreading the innovations within the university, where the work should be made tangible and visible, but also beyond in the wider community of engineering educators. Submitting work to conferences and journals makes it subject for qualified international peer review, while it also provides forms of archiving and dissemination. Together with establishing local recognition and legitimacy for the educational innovation at TU Delft, such traditional research outputs also serve as recognised merits in an academic career. This is of particular importance since the Dutch academic career system is currently open for reconsideration, and there is a need for role models with regards to careers in which education is emphasised.

Combining innovation and research is not trivial, however. For those who base their scholarship on educational innovation, as the IDEE educators are expected to do, the challenge is to make direct impact within their own environment, *and* to design and publish their work in a way that is both scholarly and useful to others.

5.2 Worthy Ambitions

IDEE sets the ambitions high, but the aims are worth striving for and the conditions have arguably never been better.

The legitimacy of IDEE will rest on its ability to create positive impacts on education, to enable addressing the challenges in education and driving innovation. Therefore, the work needs to be locally embedded in contexts where the real, practical problems exist, and where experimentation can take place under realistic conditions involving students and staff. This is where the ideas must prove their usefulness. Impact is likely to be created through the process (rather than just by the research output on its own), especially through collaboration with colleagues and students in the different educational contexts.

Research output plays a key role for creating a strong presence and recognition in the research community. This is important for IDEE as a whole, and for the involved individuals. Since the themes that will be addressed in IDEE have emerged as

strategically important within TU Delft, they are likely to be relevant and timely also for others in the research field.

A key legacy of IDEE is the involved people. This initiative should strengthen a significant number of long-term strong supporters of educational innovation and research. The people involved should develop attractive expertise, capacity to handle educational challenges, and ability to lead future endeavours. Their long-term career is a showcase for the model and an important indicator of success; it will also be seen as an indicator for the importance of education at TU Delft.

6 ACKNOWLEDGEMENTS

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