Preparing engineering students for tomorrows challenges:

Investigating challenges to support interdisciplinarity

Applicants

Isabelle Reymen (innovation Space, main applicant)
Chantal Brans (innovation Space)
Antoine van den Beemt (ESoE)

Background and justification of the project

TU/e innovation Space offers an environment that encourages, stimulates and facilitates students to work in interdisciplinary teams on real-life challenges that directly impact our world (Reymen, 2019). These challenges are often open-ended and ill defined (Gómez Puente, Van Eijck, & Jochems, 2013) and require a shared language for collaboration and interdisciplinarity to facilitate learning processes (Van den Beemt et al., accepted). This language should be shared among stakeholders, including students, teachers, and industry or NGO's. However, little is known about design characteristics that make these challenges work and what should be done to support interdisciplinarity in innovation Space education.

Objectives and expected outcomes of the project

This project explores innovation Space challenges with the purpose to find a shared language that supports interdisciplinarity in engineering education. The result is (1) a description of interdisciplinarity in innovation Space education, to be shared with stakeholders, and (2) characteristics of challenge-based learning in innovation Space that support this interdisciplinary engineering education (IEE).

The working definition for interdisciplinarity in education that studies of IEE seem to agree on is that interaction between fields of expertise requires some level of *integration* between those fields to count as "interdisciplinary" (Klein, 2010). Interdisciplinary interactions can be considered as attempts to address societal challenges by integrating heterogeneous knowledge bases and knowledge-making practices, whether these are gathered under the institutional cover of a discipline or not (van den Beemt et al., accepted). The result, at least in theory, is that participants emerge from such interactions speaking "one language."

Many universities are embracing the concept of 'challenge-based learning' (CBL), to better prepare students to contribute to societal challenges (Tassone et al., 2017). CBL is an interdisciplinary experience where learning takes places through identification, analysis and collaborative design of a sustainable and responsive solution to a real world – authentic - sociotechnical problem (Malmqvist, Rådberg, & Lundqvist, 2015). CBL at least involves (1) open ended problems from real world practice that require working in interdisciplinary teams, (2) entrepreneurial acting and design thinking, (3) combining disciplines, and (4) linking curricular and extracurricular activities (Reymen, 2019).

The core research question is: *what design characteristics for innovation Space challenges support interdisciplinarity in engineering education?*

Given the purpose of this project, this research question can be divided into sub questions:

- What kind of interdisciplinarity can be found in innovation Space projects and courses?
- What kind of challenges can be found in innovation Space projects and courses and on what design characteristics do they differ?
- What motivates students to undertake CBL activities and how do these motives differ per type of student?
- How does student learning change when challenges are altered to become more interdisciplinary, and while controlling for student motivation?

Project design and management

To answer these research questions, a multiple case study including four innovation Space projects and courses will be conducted. Triangulation of data collected on the cases will provide a comprehensive picture of what design characteristics really make innovation Space challenges work in terms of interdisciplinarity and student learning. To identify characteristics of interdisciplinarity (RQ1) and challenges (RQ2) in Q4 2019/2020 the courses 1ZM150 (ISP, GS), 1ZAUB0 (USE – entrepreneurship in action, BC), and the Food for Health and Safety Challenge (F4HS, interuniversity Bachelor and Master's) will be followed. Data collection consists of interviews with teachers involved, a focus group interview with students, document analysis of course materials, and course-evaluations and innovation Space evaluations.

To identify students' motives (RQ3) validated motivation instruments will be used as starting points for quantitative and qualitative data collection (e.g., IMI-questionnaire, and Value Creation Framework). To make student learning (RQ4) visible, the learning gains frameworks of Vermunt and colleagues (2018), and Van Uum and Pepin (https://www.4tu.nl/cee/en/news/learning-gains-framework/) will be used.

This leads to initial answers to research questions RQ1, RQ2, and RQ3 by September 2020.
The descriptive stage will be followed by a design research set-up in Q1 and Q2 2020/2021, and in Q3 and Q4 2020/2021. Again, 1ZM150 will be topic of research, as well as the courses 1ZAUB0, 4WBB0 (Engineering Design, BC). Data collection in these stages consist of interviews, focus group sessions, course evaluations, and interventions that result in effects on interdisciplinary cooperation in innovation Space challenges.

Dissemination and sustainability of the project

The preliminary project results will be presented after Q4 2020 in a short report. The final results will be presented after Q4 2021 in an end report. Both reports are to be shared with teachers and other stakeholders. Furthermore, the project will be presented at occasions such as the innovation Space education day, and 4TU CEE innovation conference. The project will result in at least one conference paper, that serves as the basis for an article to be published in an international peer-reviewed journal.

The project results also include practical tools such as guidelines for teachers concerning the design of challenges that support interdisciplinarity.

References

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