D5.2 - Joint Research Projects


Introduction

Next to the work packages introducing methods and activities (WP2-3-4) and the monitoring (T5.1), the Joint Research Project within the EuroTeQ Engineering University (T5.2) will set up a strong collaborative research to create feedback during the project to increase the overall project's efficiency and impact. Joint Research Project adds analytical value to the measured Key Performance Indicators (KPIs) that have been set up in the D5.1 of the EuroTeQ project.

The Joint Research Project starts from the overall objective of the project as described in the summary of the proposal. "As six leading Universities of Science and Technology, spread across Europe, situated in innovation eco-systems and with great collaboration experience, we are equipped to introduce a paradigm shift in the engineering education of the future, aspiring responsible value co-creation in technology. To provide excellent education to our future engineers and to engineer the University of the Future, to become a role model for the European Higher Education area and beyond."

This document describes the Joint Research Project proposal based on discussions in WP5 and input from a questionnaire in the entire consortium to collect relevant research topics.

Within the project proposal, individual questions and target groups will be involved. The research methodology, individual tools and selection of target groups will be specified. The project proposal will define and implement the means of observation. Furthermore, a system for the achieved data evaluation will be designed.

Main Target

The main target of the Joint Research Project is to inspire a new research community, do research on the effect of the entire project and stimulate feedback and discussion throughout the entire consortium how to further improve quality of engineering education at the EuroTeQ universities and actively assess the interaction with different societal actors and the potential impact of a paradigm change in education.

Research Questions

This research aims at tracing the development of students' dispositions and skills over time during the participation in activities of the EuroTeQ Project.
Therefore, the relevant question is how these dispositions and skills develop depending on the kind of activities that the students participate in and their individual entry requirements, in terms of dispositions and skills.

Research will pay attention to the overall perspective of how to encourage, improve and assess learning within today's society, that include a perspective on

- the different accessible tools e.g Analyses of learning outcome, Analyses of impact of different didactics (e.g. e-learning, peer-to-peer-learning, classic teaching, master teaching etc.), Learning impact and learning statistic,
- the population of today, which based on various research results is different from 10,20,30 years ago.

The following overarching research question have been derived:

What added value does this new educational approach bring to

- future engineers, in terms of
    - Attitudes
    - Knowledge and competences
    - Professional identity
    - Motivation
    - Epistic views
- future engineering education and its ecosystem, in terms of
    - Educational vision
    - Engineering pedagogy
    - Diversity and inclusion

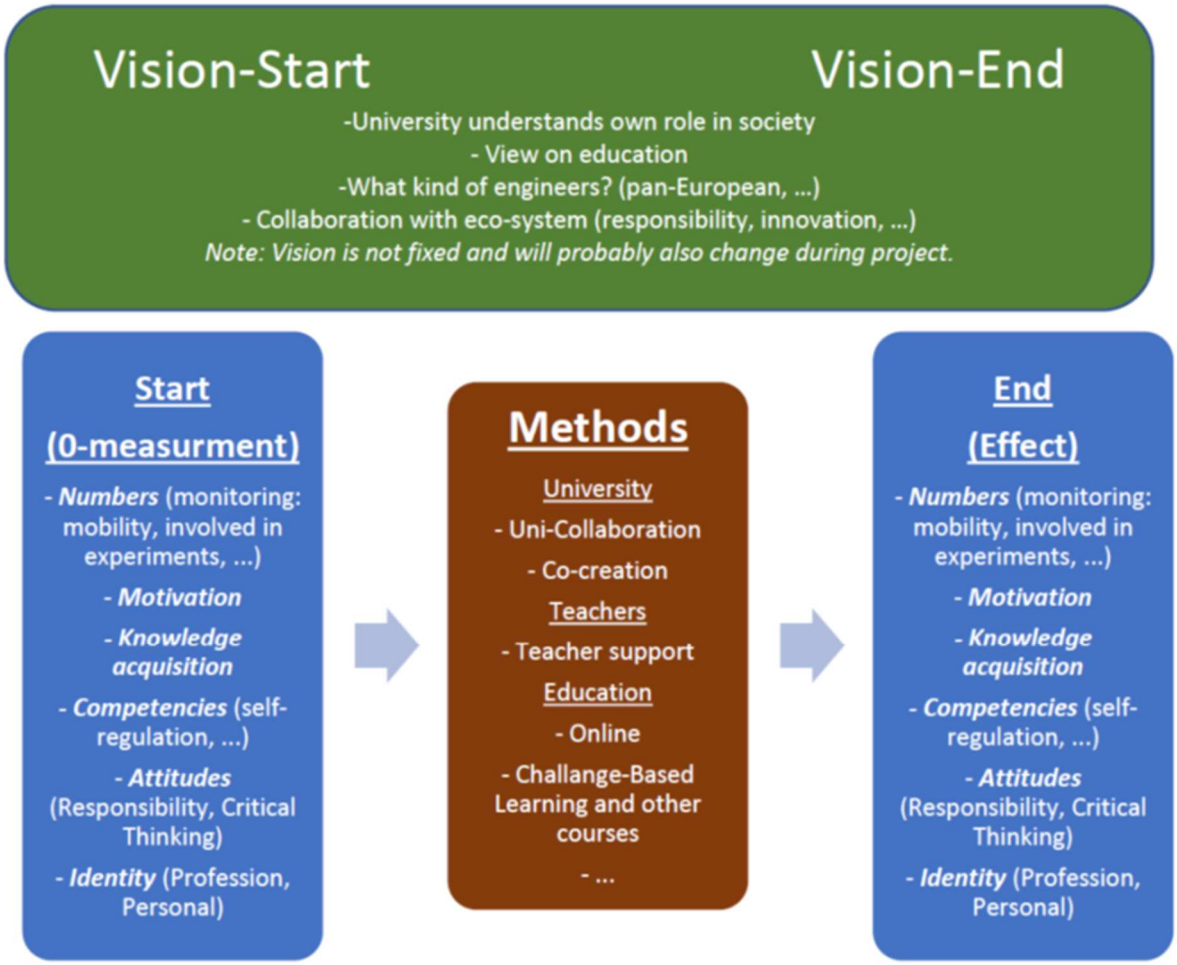
Research Set-up

In order to provide a feedback to the consortium, the Joint Research Project will operationalise the evaluation of the overall aim “introduce a paradigm shift in the engineering education of the future, aspiring responsible value co-creation in technology” and “to provide excellent education to our future engineers and to engineer the University of the Future, to become a role model for the European Higher Education area and beyond”. It will study aspects of engineering education relevant for this overall aim at the start and at the end of the project.

It will do this in a systematic way. Judging if something is “a role model” or “excellent” means clearly being aware of its criteria. Therefore, part of the research will focus on how the criteria for "role model” and “excellent” are defined and used. We will focus on how the universities see their own role in the co-creation processes they are in with thier research *and* their education, what the views of education are, what kind of engineers the universities what to educate, how responsibility is important at the university and ecosystem level, and how the partners in the ecosystems see and evaluate this.

The insights in these views will be used to evaluate aspects of the set-up. As scientific inquiry needs a focus on concepts linked to particular theories in order to be able to do in-depth research, we propose here a focus to operationalize the evaluation and feedback work done by the Joint Research Project. In the current specification, we use the input of the questionnaire performed in the entire consortium.

- Study the ***vision*** of the different universities.
- ***Numbers*** can be monitored, looking at the impact in the universities.
- ***Motivation*** of students and teachers is seen as an important element. Motivation can be considered as a prerequisite of the students, as a process variable and as an outcome variable.
- An important concern from many teachers is whether the new methods (e.g. Maker Spaces, Challenge-Based Learning, Problem-Based Learning) provide sufficient ***knowledge acquisition***. Do the new formats make students acquire the same amount of knowledge? Is this other knowledge?
- Overall, it is expected that the new educational formats will lead to other ***competence developments***. Which competences are less or more developed by this education? How do partners in the eco-systems evaluate the new competencies? Which 21st century skills (e.g. critical thinking, (cooperative) problem solving) will be fostered by the EuroTeQ-activities and how do they develop over the time of the participation?
- Next to competences, “introduce a paradigm shift in the engineering education of the future, aspiring responsible value co-creation in technology” requires looking at crucial ***attitudes.*** Which attitudes are less or more developed by this education? We particularly think about “responsibility” and “critical thinking”. One could include here the attitudes to future topics related to engineering such as “sustainability“, “digitalization“, “professional future perspectives“ (national and international). In addition, measures of “equality“ and “perception of discrimination“ could also be included here.
- And finally, how do the new formats influence the ***professional identity*** of the future engineers? How is (professional) identity developed with the new methods (and how does it differ from the previous educational methods? How does the students’ ***epistemic views*** (view on the societal role of engineering knowledge, views on engineering as science (NOS)) change. The EuroTeQ-activities might be designed as socio-scientific issues which encompass the development of a (perhaps new) self-image of the engineer as part of the society and its development. In how far this change is intended and supported by the projects and in how far this development is reached?



It would still be worth considering a process perspective for the different activities (e.g. use of digital media, group interaction, group composition, Perception of the lecture/ seminar/ the teaching)

In addition to the relevant dependent variables (e.g. critical thinking, problem-solving, dispositions) different students related control variables will be measured to ensure comparability and to explain possible variances in the results. In addition may some effects also depend on these control variables (e.g. gender, prior knowledge, age, self-regulation skills).

We indicate that these are interesting avenues. However, the further development of the research will depend on the available personal resources.

Target Groups

The proposed Joint Research Project will involve the following six target groups:

- Students,
- Applicants (high school students)
- University staff (teachers),
- Graduates (alumni),
- Industrial partners (graduates employers),
- Policy maker.

Methods

The Learning statistics and Qualitative analyses of student learning and student experiences will be evaluated and the several questionnaire surveys and monitored discussions with target groups will be conducted at all partner universities. The surveys and discussions aim to actively assess the interaction with different societal actors and the impact of the paradigm change in education.

The main focus of the survey: observation of the behaviour of the students working together with non-academics (Collider), in the different professions, with associated partners and academics which could create the wider ecosystem.
The integral part of each survey is to identify and eliminate any potential discrimination or bias towards potentially disadvantaged groups.

The key indicators from relevant areas of the educational process/project tasks will be evaluated.

- Study the ***vision*** will be done by interviews and observations.
- ***Numbers*** can be monitored with existing and new monitoring systems.
- ***Motivation.*** As some universities have experience with Self-Determination Theory questionnaires, analysing motivation and basic needs, we propose this. It would also be worth focusing on individual and situational interest as well as on expectancy value – models, because they cover constructs related to cognitive measures (such as self-efficacy)
- ***Knowledge acquisition*** *will be performed by the project team that needs to be widened accordingly*.
- ***Competence developments***. Several universities have competence measurement instruments that can be used to analyse competence developments for students and young professionals. ACQA (Academic Competence Quality Assurance) offers online competence self-assessment tool. 21st century skills might be assessed by objective tests or self-evaluation.
- ***Attitudes.*** "Responsibility" and "critical thinking" will be analysed with qualitative and quantitative methods. "Sustainability", "digitization", "professional future perspectives" (national and international), attitudes toward "equality" and "perception of discrimination" can be assessed with quantitative questionnaires.

- ***Professional identity*** and ***epistemic views.*** In-depth interviews and questionnaires.

Topic	Research methods – current plan
Vision	The vision can be analysed by the EuroTeQ-boost project on Co-Creation. The different perspectives (STS, philosophy, eco-systems research) will be used in this project.
Numbers	Numbers can be achieved by the monitoring efforts (T5.1 KPIs).
Motivation	Self-Determination Questionnaires, observations and in-depth discussions
Knowledge acquisition	widened project team
Competences	ACQA online self-, peer- and tutor-assessments; 21st century skills; Scientific reasoning;
Attitudes	The EuroTeQ-boost project will perform a qualitative analysis how responsibility and discussions about it emerge in the different universities' eco-systems. *Next to this, a quantitative questionnaire such as EPRA (Engineering Professional Responsibility Assessment) could be relevant.*
Identity & epistemic view	For example EBQ

Resources

We indicate that these are interesting avenues. However, the further development of the research will depend on the personal capacity available for research. As indicated in the table below, part of the research can be performed by the EuroTeQ-Boost project. However, other parts are currently not addressed.

Topic	Research resources and current plan
Vision	The vision can be analysed by the EuroTeQ-boost project on Co-Creation. The different perspectives (STS, philosophy, eco-systems research) will be used in this project.
Numbers	Numbers can be achieved by the monitoring efforts (T5.1 KPIs).
Motivation	*[Currently, no resources available for this.]*
Knowledge acquisition	*[Currently, no resources available for this.]*
Competences	*[Support could be performed by the Boost Life-Long Learning team]*
Attitudes	Attitudes can be partially analysed by the EuroteQ-boost project on Co-Creation and its focus on responsibility. *[But as "responsibility' is central to the project, other resources will be needed here.]*
Identity & epistemic view	*[Currently, no resources available for this.]*

Planned Outcomes

Evaluation Reports

Detailed Evaluation Report for each survey (monitoring outcomes against its stated goals, performance indicators and targets) will be created and shared with relevant stakeholders.

Recommendations

The recommendations based on Evaluation Reports will be drafted for future implementation into the relevant documents (e.g. university strategy, legislation etc.) and processes as a part of evidence-based and inclusive decision-making.

Scientific Papers

Other research outputs within the Joint Research Projects will be scientific papers published in relevant scientific journals.

Project Phases and Timing

Methodology phase

The first phase of the project will comprise the quality assurance methodology drafting and its initial testing at all EuroTeQ partner universities to eliminate major potential risks.

Pilot phase

The second phase of the project focuses on pilot verification of the developed methodology and processing of primary analyzes at partner universities. The research methodology will be modified and supplemented according to the acquired knowledge within the pilot phase of the research.

Implementation and Dissemination phase

This phase builds on the previous phases of research and includes extensive monitoring of quality assurance at partner universities, the output of which will be proposals for individual outputs intended for internal use and the public and as a basis for promoting the necessary changes.

Dissemination

The dissemination process will include the constant interaction between research and course-designers. The outputs of the project will be mostly available to the general public and will be targeted at relevant stakeholders in the lobbying for change.

Impact

The expected impact of the Joint Research Projects is the strengthening of qualitative aspects within the educational activities of the participating universities. The results achieved will help raise awareness of the social responsibility of future engineers and deepen the links between the EuroTeQ Universities and industrial partners, society and relevant stakeholders.

Research Team

The research will be coordinated by a Postdoctoral researcher from Taltech. The Postdoctoral researcher will be engaged during the following months. Every partner university will have a dedicated staff member working for the Join Research Project.