



Summary CEE Kick-off event

Kick-off event | Engineering Lab | Creative Lab | 22 September 2014

3TU.

CENTRE FOR

ENGINEERING EDUCATION

Welcome to the Labs!

In this era of fierce industry competitiveness, educational institutions -especially in the engineering field- are continuously searching for new ways to improve the quality of their education.

To support teachers coping with challenges in engineering education and to provide them tools for improving their education, the 3TU.Centre for Engineering Education organised two lab sessions during the Kick-off event. The two labs aimed at exploring new ways to bring innovation in the engineering education for tomorrow's engineers. Both labs used various creative problem-solving techniques that allowed the education staffs, teachers and students to collaborate in creating future visions and solutions for today's and tomorrow's engineers.

Engineering Lab

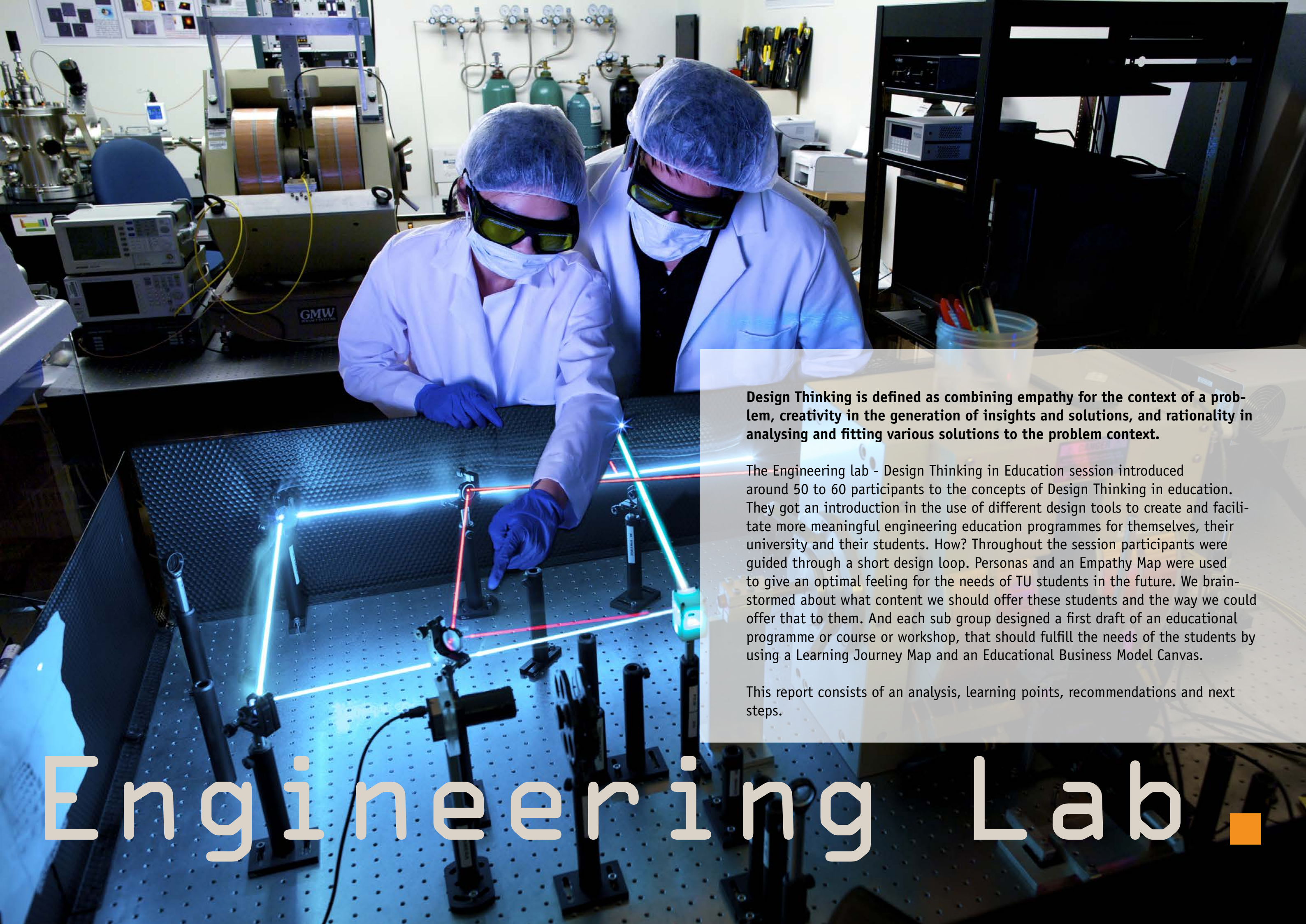
The challenges teachers are confronted with, to be able to meet the students' needs, are real, complex, and varied. And as such, they require new perspectives, new tools, and new approaches. Design Thinking is one of them.

The Engineering lab approached the challenge in macro level with a top down view. Specific Design Thinking mindset and tools were introduced and explored, aiming for idealistic visions towards the future of engineering education.

Creative Lab

Teachers, students and education staff face various challenges within the learning and teaching process. The creative lab focussed on one crucial aspect within this process; the feedback process.

Unlike the Engineering lab, the Creative lab approached the challenge on a micro level, using a bottom - up view. We reflected on the current situation and projected the learning points to create practical solutions that added value to the current and future learning process.



Design Thinking is defined as combining empathy for the context of a problem, creativity in the generation of insights and solutions, and rationality in analysing and fitting various solutions to the problem context.

The Engineering lab - Design Thinking in Education session introduced around 50 to 60 participants to the concepts of Design Thinking in education. They got an introduction in the use of different design tools to create and facilitate more meaningful engineering education programmes for themselves, their university and their students. How? Throughout the session participants were guided through a short design loop. Personas and an Empathy Map were used to give an optimal feeling for the needs of TU students in the future. We brainstormed about what content we should offer these students and the way we could offer that to them. And each sub group designed a first draft of an educational programme or course or workshop, that should fulfill the needs of the students by using a Learning Journey Map and an Educational Business Model Canvas.

This report consists of an analysis, learning points, recommendations and next steps.

Engineering Lab

Design Thinking

The Engineering Lab was facilitated by AmIa-Designer by Boukje Vastbinder and Jeroen Spoelstra. Main goal of this session was to make the participants acquainted with the Design Thinking methodology to reform their engineering education.

A famous Design Thinker is Tim Brown from IDEO. He states that people should be provided with tools that will help them deal with complex situations, wicked problems and engage the participants in our case the students. Employers ask for problem solvers and an entrepreneurial attitude. Multidisciplinary approaches become more and more important. Design Thinking is a tool through which these goals can be achieved.

AmIaDesigner

AmIaDesigner elaborated upon this methodology and stated that Design Thinking is a typical way of imaging and visualising new realities in process. Design Thinking leads to new products and it reflects the way we see the world, thinking through design creates new contexts and helps us understand the evolution of society. Education of a Design Thinker creates persons, who are competent in thinking of, about and through design.

AmIaDesigner aims at realising these goals by providing Design thinkers with the right mindset, process and tools. A Design Thinker typically

thinks in an explorative way, empathises with its users/clients or relevant stakeholders, creates, ideates, iterates and prototypes.

Design Thinking is also a misleading term as the mindset inspires DOING, making the desires of humans viable by creating added value via feasible technology.



process:

imagining, visualizing
& implementing new realities



product:

a new reality



tools:

using design tools & mindset



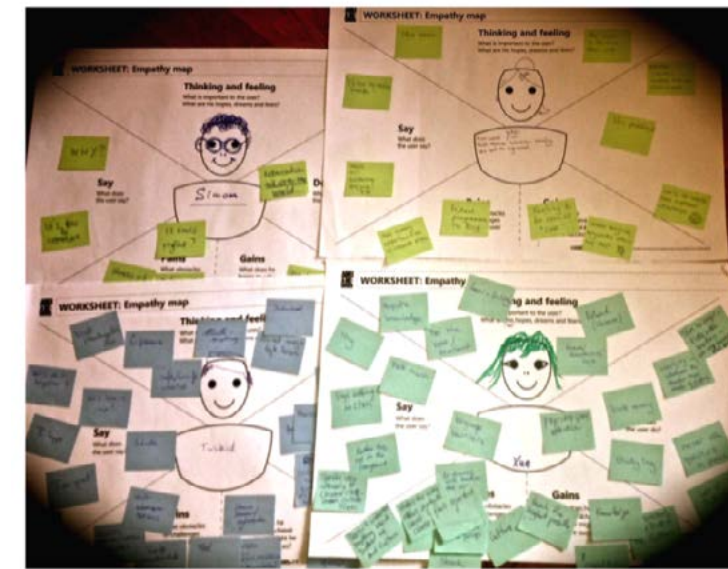
person:

competent in thinking of, about and through design

The Empathy Map

The participants in this workshop made an Empathy map, which stimulated them to step in the shoes of our students and get a different perspective of who they are. In REAL life we would interview at least 10 of them and preferably as many as possible.

In the image to the right we find a sample and a summary of the 12 empathy maps showing participants' perspectives of present day and future students.



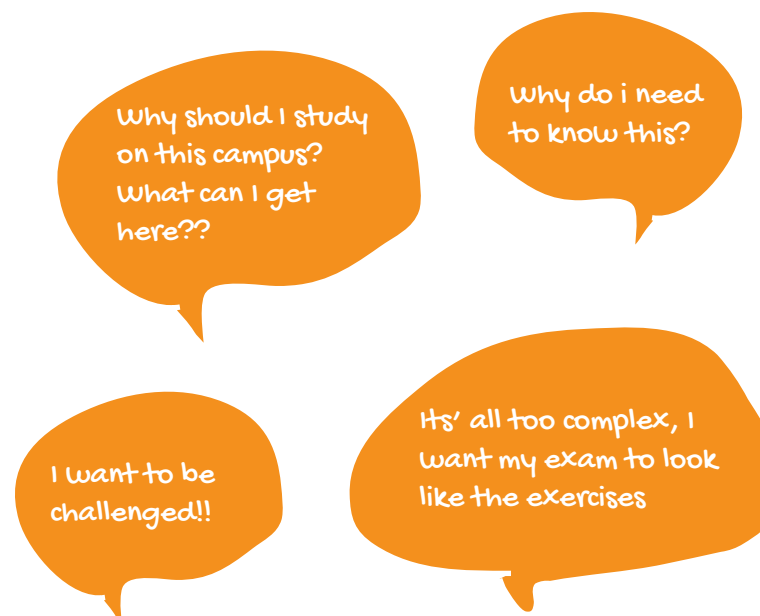
Student profile

The students of 2025 are all foreign and world citizens with friends in every corner of the world. They deeply care about safety, health, sustainable and clean environment and are eager to learn anything they can get their hands on. Preferably, in collaborative and multidisciplinary teams. They wish to be challenged, inspired and have an excellent career. For this reason these students want to know what is required from them to accomplish this great career and they worry about the question whether their education is still relevant in few years time.

Their activities consist of online networking, travelling across the world, observing, analysing and creating. Furthermore they like multi-tasking, however they do not like to do homework.

Lessons Learned:

- The empathy maps are a reflection of who our teachers are and how they view the world
- To really find out what drives our students, we need to listen to real students and not just talk to them about the content
- Is the gain really what we have to offer?



The biggest learning problems are a lack of direction or focus, information overload, stress about making choices at an early stage, fierce competition, keeping up with technology development, lack of social skills in physical environment and the discrepancy between the teachers and students way of learning and teaching.

The gain from education is social status, learning to work very hard, on authentic key societal problems in a competitive environment with access to online information sources and in a flexible context.

The Learning Journey

The resulting Concepts were:

- A shock action week for XUE
- Professional Teamwork skills for “the Tushids”
- Operation Mars for “the Yani’s”
- How to make a choice, course about travelling for the Simons
- Pressure cooker project: building games
- Modelling and Simulation activity
- A 2 hours introduction workshop “Careers for Women in Engineering” for “the Lola’s”
- Learning how to learn for ms IQ Doubt
- Critical Thinking Fundamentals for Mohammed
- Orientation and networking (BSc introduction week)

Richard Elmore from Harvard University has created the Modes of Learning Model. He points out that each one of us has a preferred way of learning, either in hierarchical systems such as formal institutions or a more personalised learning on individual basis or network environments.

Our future students typically fit the Distributed Collective mode of learning in which authentic passion and a need for learning are reasons to join online networks to learn from them and infuse them with what we’ve learned ourselves.

It may be a source of inspiration to further explore [Elmore’s modes of learning](#) to help us design future education.



Great to see how easy it can be to think and create new ways of teaching and learning. We approach it as a burden and have lengthy meetings, while we have now realised a new programme in one afternoon. Do more new/ innovative education and talk less!!

Quote from the participants....

‘Splitting content and form provides new perspectives on how to approach learning. I never realised how automatically linked they are in my design’

The Operation Mars and “How to make a choice” are only the two examples for future learning of the many great ideas staff came up with.

The most important elements are:

- A sense of urgency for learning
- Problem solving, team work and critical thinking skills
- Passion about learning
- The possibility to fail and learn from failure
- Working on real world issues that contribute to a better future
- Learning to learn
- Simulations and taking advantage of online networks to create learning opportunities
- Involving students as co-creators, inviting the world inside our universities by attracting experts and guest lecturers from the field and by going out to explore the world and learn from it.

Operation Mars

Operation Mars has a duration of one week, with a theatrical simulation of Mars or the desert. It is primarily designed to feel the urgency of learning, to learn from invited speakers and study a problem by means of interview, document study and design strategies, practical simulations and stimulates an entrepreneurial attitude. The fundamental knowledge consists of mathematics and physics. The applied knowledge with ill-defined problems. The students will operate in teams, in which they are to learn about intercultural empathy, to be a collaborative and critical producer of their own learning and their own strength and weakness. The students will work on “the problem” (generalise & contextualise) and submit a problem definition that will be worked out during the rest of the semester.

“How to make a choice?” course about travelling

“How to make a choice”, is a course about learning math, ethics and cultural understanding and the acquisition of in-depth understanding of technology in different circumstances. It is a one-day course in which students learn to make choices with respect to their own learning goals, explore the benefits of (online) travel and meet with people who travelled physically/online. The ultimate result is to decide on a travel and action plan for learning. The teachers during the travels are teachers, peers and experts of the world invited in an online learning environment. The travel plan is another word for learning plan by the involvement of teachers of the world.



The Business Model Canvas

The Business Model Canvas (BMC) for education is a final step in the Design Thinking cycle to test the viability of the newly proposed concepts.

A wide variety in partners is introduced to collaborate in education ranging from student associations to colleagues in other departments or countries to institutional bodies like 3TU.

The scope of the stakeholders has broadened to parents, society and new potential target groups for our educational propositions.

Value propositions range from: more economic value and flexibility of our graduating engineers for society to personal development and motivation for students.

The BMC offers the opportunity to broaden our scope, position our concepts and iterate on new perspectives.

Discussions

- Is education a service to students? And are students and their parents our clients?
- Should the university be seen as a [social enterprise](#)? and...
- What would be the role of the 3TU.CEE in this enterprise?
- Should teachers provide the same kind of education or a different kind of education?



Discussing Future Role of CEE

One of the questions of the participants was “can Design Thinking be used by 3TU.CEE”


The answer is “Yes, we just did. You are our empathy map, our first step in ideation towards a learning journey for teachers, students and institutional staff”. Another question concerns what the 3TU.CEE has to offer teaching staff? The 3TU.CEE is a network organisation which intends to bring parties together for professional exchange on questions that matter to teachers and their organisation. This can be realised and co-created in different formats ranging from site visits, to involvement in research or a simple phone-call and visit to our website www.3tu.nl/cee. Teaching staff will be invited to relevant events. Activities are created for those who wish to pursue a question, passion or otherwise. The 3TU.CEE will additionally support evidence-based research for institutional purposes and support innovation initiatives within education, provided that learning about these innovations is shared with each partner institution to learn from.

One very good suggestion is the creation of Educational Design teams across 3TU with co-involvement of researchers in the field and school teachers, alongside university lecturers. Another great suggestion is to reconsider the question of life long learning and what makes learning valuable for our teaching staff. Finally, some requests are about training in coaching and internationalisation that should be a focus area of the 3TU.CEE. We will consider all of these in the development of new CEE activities.

Finally we would like to finish with the following thoughts:

Learning is an act of motivation to explore new terrains which requires passion, purpose, experiment and peer involvement. You as participants in this workshop have made a first step in a new way of learning, in taking responsibility for the creation of your own learning path and creating challenging learning environments for our students. We as CEE will do our utmost to help and sustain you along the way.





Creative Lab:

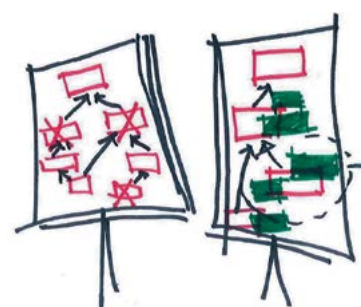
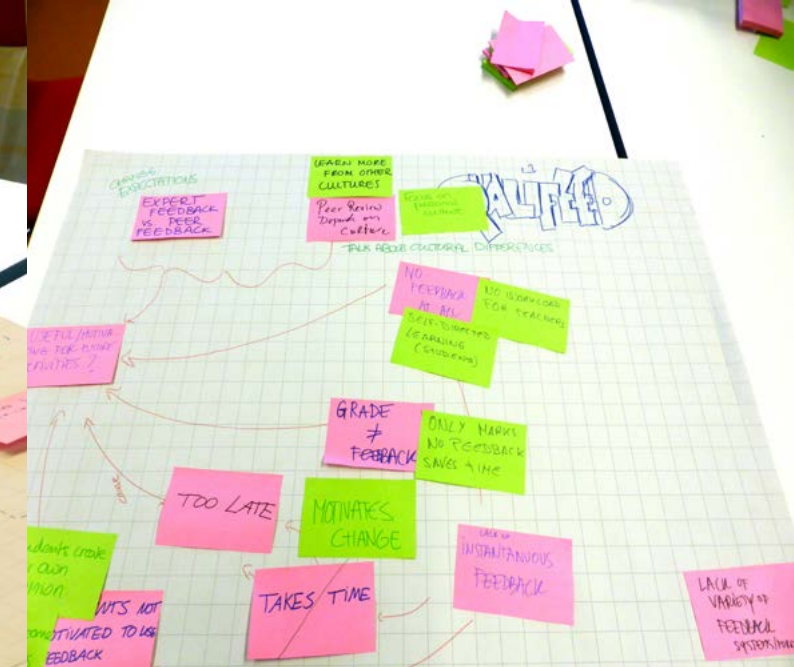
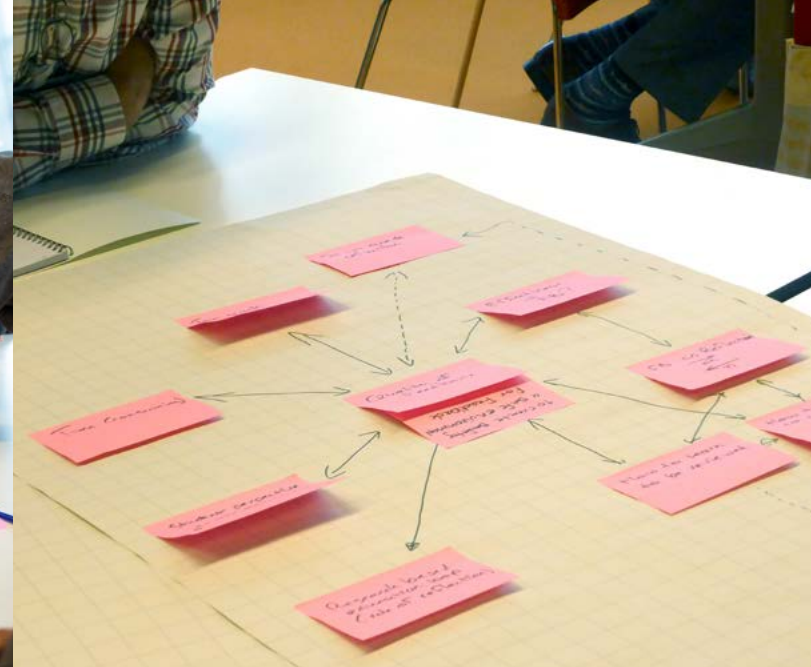
Creating new feedback methods fit for future engineers

Engineers need to experiment and fail in their studies to achieve mastery over matter. Passion and purpose are the drivers of learning. Thus educators should NOT stimulate assessment of learning, but assessment for learning; creating feedback loops in education that allow exploration of complex engineering issues, experiments, trial & errors and ultimately (re)learning iteratively.

The Creative lab used the TRIZ (“Theory of Inventive Problem Solving.”) method that reflects this specific engineers’ problem-solving spirit.

TRIZ tools are generally applied to create and improve products, services and systems. Educators always encourage their students to learn from each other, from anyone, anytime and everywhere. TRIZ does so as well with its principle:

“Somebody someplace has already solved this problem (or one very similar to it.) Today, creativity involves finding that solution and adapting it to this particular problem.”



Exploring, Prioritising & Redefining

PROBLEMS

“A clever person solves a problem. A wise person avoids it.” - Albert Einstein

Exploring and understanding problems in the current feedback methods

Each group exchanged knowledge and experiences on the current feedback methods they are using, discussed differences and similarities and finally listed 10 main problems they are facing at the moment.

Each problem could be the cause and/or the effect of another problem. Thus the participants needed to explore and map the 10 problems into a “problem tree”.

Each group had to start with 1 main problem which they considered most important. From this first problem, the participants started to build their “problem tree” and formed a cause-effect chain reaction with the other 9 problems they had identified.

We stressed that the participants needed to ask themselves for each problem “WHAT CAUSED.... (that main problem)...”

After they finished, suddenly the 10 separate problems were rooted into 1 problem tree. Did we have 10 problems? Or did we actually just have 1 complex problem?



Never analyze a problem by asking “why (this problem...) as it tends to lead you to making assumptions (subjective view) and drift you away from the facts (objective view).”

Prioritizing and reframing the problem

No one can handle 10 problems at the same time. Sun Tzu once said: “If a battle cannot be won, do not fight it.” Thus the next step is to choose the battle wisely and to focus on fighting what matters. But how can we recognise which problems are worth solving? Which is the one that matters?

We do this in 2 steps: Step 1 is to find and exclude a given problem. And step 2 is to find and include the problem that hides a positive effect/value (to anyone, not only yourself).

STEP1

Each group was asked to reread each problem one by one. While reading they needed to ask themselves:

**IS THERE ANYTHING I CAN DO TO CHANGE THIS?
CAN I INFLUENCE SOMETHING?
OR IS IT A STATED SITUATION?**

Most participants found that some problems are actually a stated situation; something they hardly can influence, let alone solve. Thus these problems must be discarded.

Even though the participants understood that many problems were actually not “their problem”, most of them experienced that it was very hard to discard a problem. Some felt worried, scared or anxious to focus on what really matters.



The positive effect revealed behind a problem is what TRIZ defines as a **CONTRADICTION**. If we can solve the contradiction, we are basically not only solving a problem but also creating added value to various stakeholders. In fact all of the world's great inventions were created because someone had a problem with something and someone else managed to reveal a new added value to it.

STEP2

Each group was asked to reread the remaining problems one by one. While reading they needed to ask themselves:

**IS THERE ANY POSITIVE EFFECT GAINED FROM THIS?
WHO GAINS VALUE/BENEFITS FROM THIS?**

In the beginning the participants barely managed to find any positive effects for the problems. Then once they were encouraged to broaden their view beyond their own benefit, most of them found that there was almost always a positive effect to be found. The problems that reveal a positive effect are the ones which are worth the fight.

Did you know????

Before the session we assumed that the biggest challenge of creating new feedback methods was that the participants, consisting of students, teachers and education staff would have totally different desires on such feedback methods.

During the session the participants listed up to 60 problems. Interestingly we found that they shared similar, if not, the same concerns, worries and desires for a better feedback method.

The common ground was the feeling judged during feedback sessions instead of feeling stimulated and supported to do better.

Learning Points...

"I didn't realize that analyzing our problem using specific questioning methods would make such a huge difference. By asking "WHAT CAUSED" a problem we were forced to be more objective and realistic."

"It's hard to admit, but when we got the chance to cross some problems out, we actually refused to let go of our problems and to choose the problem that counts..."

"Once I realize that what is problematic for me could be beneficial for others, it helped me to look at the problem from a totally different and positive point-of-view. Now I can also focus on dealing with the person who benefited from my problem."

Turning CONTRADICTIONS (positive effect and negative effects) into actionable challenges

The session revealed many contradictions. Each group wisely chose one contradiction to solve. We then turned 6 chosen contradictions into 12 actionable challenges. We have clustered the challenges into three themes:

1. The person

There was clearly a fundamental need to start focusing on the person behind and within the process. The real value of feedback is not for the sake of applying feedback but actually developing someone, either the students or the teachers. Thus some contradictions occur between the need for personalisation and personal development while keeping objectivity and standard.

Challenges

- How to eliminate the impersonalised feedback
- How to eliminate generic feedback that is not personalised
- How to eliminate the childish way of controlling students
- How to eliminate feedback given to large groups
- How to eliminate skeptical and critical attitude as a peer reviewer



TIP: Rephrase a problem from a descriptive form into a call-to-action form to trigger solution ideas by starting with "HOW TO..." or "HOW CAN YOU"...



The Marshmallow Challenge

We deliberately set participants apart from the problem for a while to focus on experiencing the collaboration between different mindsets, ways of working and communication styles. Thus we arranged a marshmallow challenge to let the participants switch their mindset from an analytical to a collaborative mind-set.

Despite all differences, all groups succeeded in trying to build the tallest spaghetti tower with a marshmallow sitting on top. They learned to bridge the differences and achieved a shared goal.

This exact mindset and work ethic is crucial in a problem-solving process.

Want to try it with your students? check out www.marshmallowchallenge.com



2. The value

One of the main insights was about the value of feedback. It should aim to improve the future work. This means it should not focus on what has already happened (the past), which demotivates the students, but rather focus on the future, which motivates students to move on and achieve better results next time.

Challenges

- How to maximise the ability to graduate without too much unnecessary criticism and too many obstacles
- How to maximise the positive effect of a learning community
- How to maximise the motivational effect of positive feedback to both students and teachers

3. The impact

Another strong insight was the fact that feedback should be transparent and not only benefit one person. It was believed that with ICT tools anyone can be encouraged to be open, to share learning points and to proactively seek feedback. The time and energy invested will create a snowball effect for the broader community.

Challenges

- How to maximize the effectiveness of the feedback within its time constraints
- How to eliminate ineffective way of giving feedback
- How to maximise the feedback process efficiency for the teachers
- How to maximise the creation of new feedback forms (embracing technology)

Turning PROBLEMS into actionable

CHALLENGES

"We can not solve our problems with the same level of thinking that created them" - Albert Einstein



Generating Ideas & Developing valuable solutions

"Learn from yesterday, live for today, hope for tomorrow. The important thing is to not stop questioning."

- Albert Einstein



Learning Points...

"I thought generating ideas required special talents and only so-called creative people can do it. I am surprised with how many ideas came up in such such a short time!"

"When we rephrased our problems and the positive effects with 'how to' it suddenly became something that motivated us to take action instead of paralyzing us"

"It's inspiring to hear different concepts presented by each group and it's great to hear from Ruth about the value of our concepts to change the future of engineering education."

Creating concepts for new feedback methods fit for tomorrow's engineers

Up to 300 ideas were created. Each group chose 10-12 ideas that they found most interesting, and used these as building blocks to develop their concept for creating a new feedback method.

6 concepts were developed:

- Socially Qualifeed
- Professional teacher development
- The triple F (FunFeedForward)
- Cascading Feedback
- Socrates is back!
- Rewarding Feedback: It's Encouraging learning

Each group pitched their concepts and we invited dr. Ruth Graham to choose the three winning concepts.

All 6 concepts revealed various added values both for students, teachers, education staff and even for the management team! Interestingly all concepts were aligned with the themes of the challenge. Some of them focussed mainly on the importance of valuing the personalised development, while

others focussed more on the rewarding and motivating value or on the broader impact of a learning community.

Dr. Ruth Graham finally chose three winners and revealed valuable insights for future feedback methods:

1. Building TRUST

This is about valuing someone (The Person) behind feedback as a system. The core of valuable feedback actually starts with trust before the feedback is provided. This involves not only trusting one another but most importantly trusting oneself. By trusting that people have good intentions the effect of any type of feedback system will be enhanced.

2. Involve industry

Students experience the relevant value of what they are doing in their studies for the industry. This will motivate them to proactively seek feedback instead of passively receiving it because they feed the impact they have on the real world.

3. Pay it forward – snowball effect

Once you feel the benefit of good feedback you will be motivated to share this with others around you. Thus a good feedback system creates a snowball effect; minimum effort with maximum impact.

- End -

A special thanks goes out to all who have undertaken the effort visiting the 3TU.CEE kick-off event on Monday 22 September and joining us in our journey of exploring innovations in engineering education at the three universities of technologies.

The Creative and Engineering lab have both offered a new way of dealing with problems in engineering education. In this report we provide a brief summary of the possibilities these approaches create for the development of future engineering education.

To conclude we would like to extend our thanks to Boukje Vastbinder and Jeroen Spoelstra of AmIa-Designer who facilitated the Engineering Lab and Lili Sukirman who facilitated the Creative Lab and developed this report.

The 3TU.Centre for Engineering Education team

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Design by Lili Sukirman