



CHALLENGE BASED LEARNING @UT

WHY, WHAT, HOW

RESPONSE OF SHAPING EXPERT GROUP INNOVATION
OF EDUCATION TO ASSIGNMENT OF UCOW

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CONTEXT:

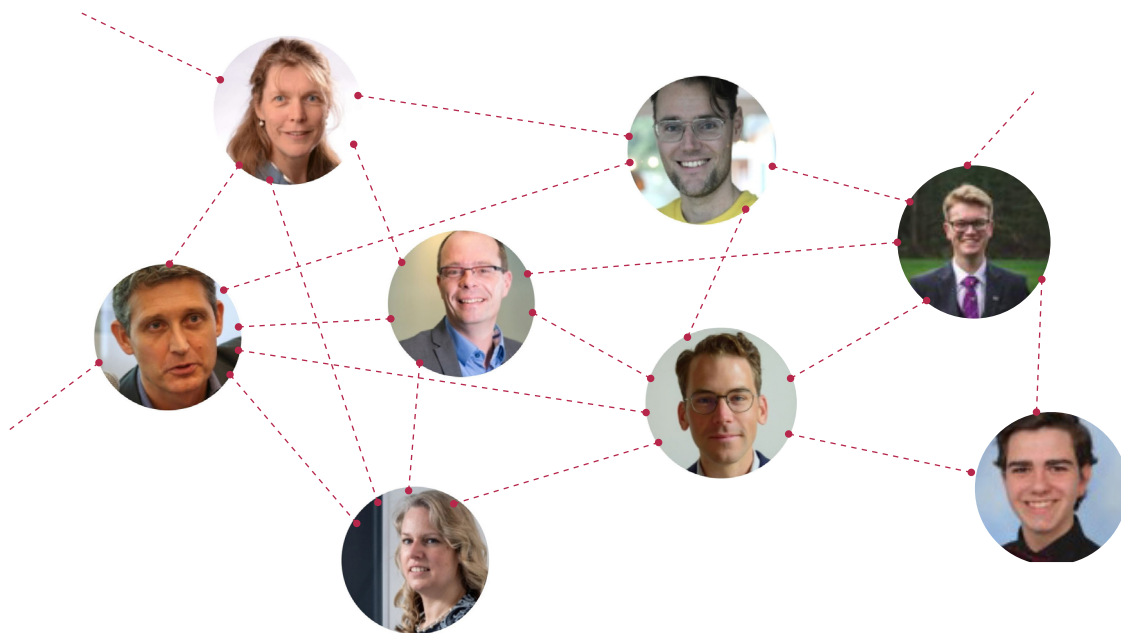
In March 2021, the UCOW gave an assignment to the Shaping Expert Group Innovation of Education (SEG IoE). The process followed to obtain an answer to this question, is described in a separate document. In the current document, the original question and the outcomes of the process are described.

THE ASSIGNMENT OF THE UCOW TO THE SEG IOE

The UCOW supports the initiatives that exist in the context of challenge-based education. However, the initiatives and needs differ per faculty. The UCOW therefore fears a diverse interpretation of the concept: what is CBL and what are challenges? For this reason, UCOW believes that an unambiguous definition should be established.

The UCOW therefore asks the SEG IoE to:

- Form a working group with program directors under the leadership of one of the vice-deans
- In collaboration with this working group and ECIU, make a move towards a definition of CBL and a definition of challenges
- Submit the widely supported definition for advice to
 - o the educational innovation platform for advice to the UCOW,
 - o the UCOW of June 1st for advice to the Executive Board
 - o the Executive Board for approval before the end of the academic year



1. INTRODUCTION

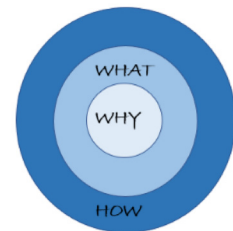
To answer the question of the UCOW, the members of the SEG IoE have, during the last couple of months, spoken with at least 40 colleagues and students during five different sessions and in eight break-out rooms. More explicitly, we had

- two sessions with the Higher UT management at the UT Heiday in March 2021;
- three sessions with several colleagues and students focusing on the assignment of the UCOW: an expert session on 28 April with CBL experts from ECIU/ Designlab/ BMS/ CEE/ ELAN; a review sessions on May 18 with programme directors and teachers; and a review session on May 19 with Vice Deans and colleagues from Strategic Business Development.

In all sessions, students were present. A special *process* document is written, describing the process of the sessions and the names of the participants.

Although it is impossible to reflect the richness of our discussions in one single document, we will do our utmost best to bring interesting questions, suggestions and ideas to the stage. The structure of the document follows the questions of Simon Sinek in a somewhat different order:

1. **What** is challenge based learning; What are challenges; What is the difference with Project and Problem Based learning?
2. **Why** would we do CBL @UT?
3. **How** to do CBL? What are relevant processes to be aware of, what different roles can be discerned?
4. **Outlook**



2. WHAT IS CHALLENGE BASED LEARNING?

Challenge-Based Learning (CBL) is a pedagogical approach that actively engages students in a situation that is real, relevant and related to their environment. Core to CBL is that learning is driven by challenging, open-ended problems that have multiple solutions. CBL builds on the foundation of experiential learning (learning by doing, surprises, and set backs). In CBL the learning process is more important than the outcome (solutions).¹

2.1. WHAT IS A CHALLENGE?

Challenge Based Learning is a vision, implemented via one of the many frameworks that exist. In this document, the Apple framework is used (see [toolbox CELT](#) for more frameworks). CBL starts with a problem (see Figure 1) defined by the problem owner (company, organization, society). The problem is wicked, meaning that it is complex, controversial and that no solutions are readily available. These wicked problems become clear in a negotiation process between problem owner, teachers and students. All work together in defining essential questions – questions that are asked when discussing the problem. Based on that discussion, the group of students decides on the question they want to investigate further and translate this into a concrete and actionable challenge. This challenge turns the essential question into a call to action to learn deeply about the subject and to find a solution.

So, in conclusion: The problem is defined by the problem owner; this problem should be wicked, open ended. The challenge, formulated in a negation process between students, teachers and stakeholders, should be a call into learning about the subject and into action to find a solution.

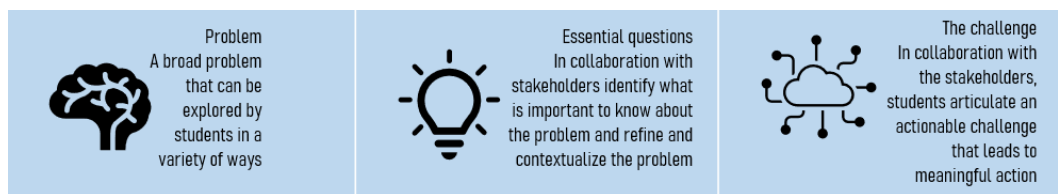


Figure 1 Phase 1 in CBL approach: **Engage**, consisting of the steps **Problem** [the problem is often presented by the problem owner e.g., a company, organization or an individual]; **Essential questions** [In collaboration with stakeholders learners identify what is important to know about the problem and refine and contextualize the problem]; and **Challenge** [In collaboration with the stakeholders, students articulate an actionable challenge that leads to meaningful action]. Figure 1-3 are based on the CBL framework as presented in the CELT toolbox¹.

2.2. WHAT DISCERNS CBL FROM PROJECT AND PROBLEM BASED LEARNING?

CBL shares characteristics with Project Based Learning (PjBL) and Problem Based Learning (PbBL). In both PjBL and CBL students are engaged students in real-world problems, however CBL offers more open general problems from which the student can determine the challenge to be tackled.

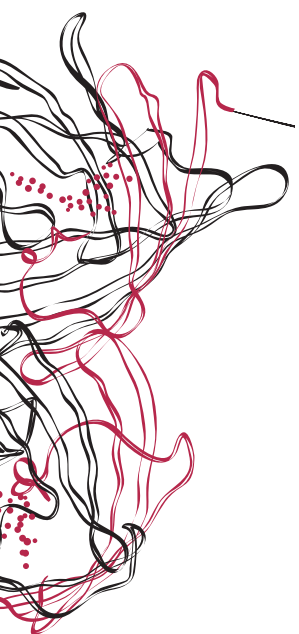
In both PbBL and CBL students engage in a collaborative learning setting related to the physical or social environment, however PbBL employs fictional cases. In PbBL the goal is not to solve the problem itself, but to use it for the development of learning. More on this topic can be found in reference².

2.3. WHAT ARE THE MAIN CHARACTERISTICS OF CBL MENTIONED IN THE SESSIONS?

The SEG IoE organized five sessions on CBL. During these sessions, quite some characteristics of CBL were mentioned. These characteristics can be summarized into in a couple of categories. Firstly, **the problems students can work on have an authentic character**, implying that these problems stem from (current) real life. They are current and/or societal problems for which different solutions are possible, or complex problems that need a multidisciplinary solution (including humanities). Within CBL students can break down these wicked problems and have the freedom to choose which of those aspects they want to work on, thereby creating their own learning path.

Secondly, looking **at the character of teamwork**, our participants mentioned that it has both an interdisciplinary and transdisciplinary character. In CBL student, staff and challenge providers collaborate during whole trajectory, which gives team work an extra dimension compared to a regular project. The *interdisciplinary teamwork*, in which multiple disciplines come together and thus new knowledge is made, also facilitates the development of *transdisciplinary knowledge* which is based on learning from experience. In transdisciplinary working, one acknowledges the value of non-academic knowledge by adding knowledge gained by experience (experiential knowledge).

Thirdly, during the sessions, students and teachers mentioned **that student learning in CBL is characterized** by being challenged and daring to cope with uncertainty in real life situations. Students mentioned they applied theory in practice, met stakeholders in every facet of the process and felt encouraged to develop an entrepreneurial spirit (e.g., assertiveness as you have to contact the stakeholder, creative thinking, risk taking). During the process they *reflected* on and learned from their experiences, which counted as formative assessments. The final assessment is both on the CBL process and the final outcomes.



3. WHY SHOULD WE DO CHALLENGE BASED LEARNING @UT?

During the sessions, the added value of CBL has been explored from different perspectives.

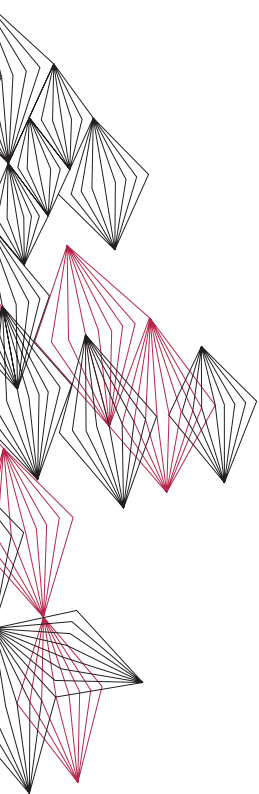
Listening to students and teachers, it was mentioned that students like the opportunities CBL offers for the development of a more interdisciplinary view so that they learn to take different perspectives and to thrive in interdisciplinary working environments. Students want to explore socio-technological implications of challenges, want to create relevant solutions with impact and meet their future employers in action. Regarding their academic skills development they mentioned they see opportunities for development of a critical mindset, becoming more self-confident and improving communication skills. All in all, lots of motivation, although one should be willing to deal with some 'insecurity'. An interesting added value is the possibility for students to have more freedom in choosing their own focus in what they want and need to learn in order to work on a challenge, e.g., to become experts within a certain focused, in other words: **personalized learning**. Students can define, in collaboration with their peers and stakeholders, their own challenge related to a certain problem. In addition, the option was suggested to involve stakeholders in CBL-processes in such a way that the stakeholders themselves become (Life Long) Learners.

From a **teacher** perspective, our colleagues from ECIU mentioned that quite some UT-teachers are interested in doing a pilot with CBL: some are active as a tutor in one of the challenges of the ECIU, others want to start their own CBL activity. In addition, recently seven teachers were appointed by the rector, funded by CEE and the faculties, as (senior) Teaching Fellows. These Teaching Fellows will develop one or more CBL-activities following a scholarly approach. The findings of these educational pilots will be investigated and synthesized. In another pilot, seven teachers are working on obtaining their UTQ following a CBL-approach. All these pilots show that teachers are willing to invest time and energy in new ways of teaching. Finally, the investigation into the CBL-readiness at the UT, performed by master student Afzali under supervision of Loohuis & Bosch-Chapel, gives insight in how many CBL-elements are already visible in our education. They found that almost half of the master course coordinators scored their course above average on the presence of CBL characteristics in their current course and that teachers see possibilities in increasing the level of CBL in their course³.

With the perspective of the **external partners** in mind, UT-researchers and colleagues from Strategic Business Development mentioned that CBL could be used to create stronger relationships with external partners such that industrial and societal partners can be involved in UT education. The UT-colleagues in our meetings also mentioned that this perspective and the added value of being involved in CBL should be investigated more. (for Partners this could also be linked to their LLL Ambitions).

During the session with the **programme directors**, different opinions were expressed. Some called CBL another way of learning, that might support the students in internalizing the knowledge. They would love follow-up sessions to explore the possibilities for their programme. Others recognized the need for changing our education, however, they were unsure whether CBL would be the right way to do so. An issue mentioned was the balance between depth versus broadness of the education of a student. Suppose a student comes from a broad bachelor, and wants to specialize in a certain direction – can that student still follow a disciplinary programme, or is CBL all over the master? (see also *Outlook*).

From the **perspective of the future**, the necessity of innovation of our education was stressed during the sessions. To increase and assure the added value of an academic degree (education) and thereby secure the competitive position of the UT, we should be able to react fast to the demands from society, industry and students. As a university we should be able to respond the demands like flexible learning paths, transferable skills, interdisciplinary collaboration, stakeholder and community involvement, authentic learning and real-life problems. Therefore, to ensure future proof education, we must innovate, irrespective of the model.



4. HOW TO DO CHALLENGE BASED LEARNING? PROCESSES AND ROLES.

4.1. PROCESSES

Challenge Based Learning follows a **workflow** that mirrors the 21st century workplace. Students are given enough space to be creative and self-directed and at the same time are provided with support, boundaries and check-points to avoid frustration. The workflow can be structured and modified in a variety of ways. The processes represented in figures 1-3 (Engage, Investigate, Act) can be a starting point but is not meant to be prescriptive.

At the moment the UT offers a broad spectrum of CBL originating from this basic model (see also the [Toolbox CBL from CELT](#)). The ECIU offers CBL in extra curricular activities like the [Autumn Challenge](#). Around 40 students from different countries worked on challenges from external organizations. CBL is also offered within the curriculum (e.g., in the Minor Science to Society, the elective Weather Analysis, the master [Spatial Engineering](#)). CBL has been applied for several years in the minor [New Technologies Business Development](#). For several years now, Raymond Loohuis works closely together with external organizations for concrete problems and challenges that students in his minor can work on.

During the sessions with experts, teachers and students it was stressed that students need support in the learning process, and that CBL needs to be embedded carefully in a learning line.

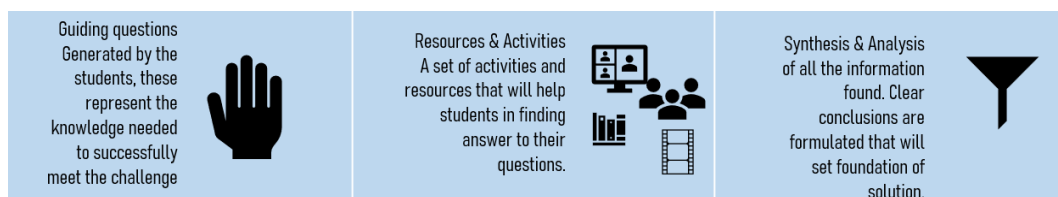


Figure 2 Phase 2 in CBL approach: Investigate; students formulate **guiding questions** that represent what they need to know in order to be able to meet the challenge; Guiding activities and guiding resources might go hand in hand: students know they want to talk to an expert (**guiding resource**) and ask for more information (**guiding activity**). the Investigation phase concludes with a Synthesis, an analysis of all the information found. At the end, the group demonstrates that they have successfully addressed all of the questions and developed clear conclusions that will set the foundation for the solution.

In addition to the learning process, several other processes are relevant to organize CBL, like **retrieving problems from stakeholders** with aspects as stakeholder management, matchmaking between stakeholder and teacher, facilitation of the contact between stakeholder/teachers/student; the **organizational process** with aspects for scheduling activities, enabling cross disciplinary activities.

A process that needs special attention is **assessment**. "In CBL the process and product is measured with both conventional and real world assessment methods. The assessments should inform and provide feedback on the effectiveness of students' efforts and depth of their content knowledge. In deciding how to assess the process and products, appropriate emphasis on three areas should be placed: content knowledge and understanding, mastery of real-world skills, and the process of CBL. Both formative and summative assessment strategies can be used to measure progress, e.g., papers, quizzes, examinations, journals, peer reviews, teacher observations" . More on this topic is elaborated in reference ⁴.

4.2. ROLES IN CBL

In Challenge Based Learning three important **roles** can be discerned.

- **Stakeholders/problem providers:** They provide the problems, represent a view on the problem. For them it might be interesting to get new ideas for solutions of specific problems and/or have access to creative thinking by students. They play a role in guiding and supervising the students.
- **Academics/teachers/researchers:** they play an important role in using their existing network to build relationships with external stakeholders and are central to ensuring the quality and workability of the challenge. They have an important role in guiding and supervising the students.
- **Learners/Students:** they play a crucial role in the identification and shaping of challenges and coming up with their solution for the problem.



Derived from these three roles, other roles should be mentioned here as well, e.g., *contact persons* between stakeholders and teachers; *educational advisors* in supporting the teachers how to design CBL-activities; *trainers / coaches* for both teachers and students to support them during the CBL activity. Roles and responsibilities are described in more detail in reference⁵.

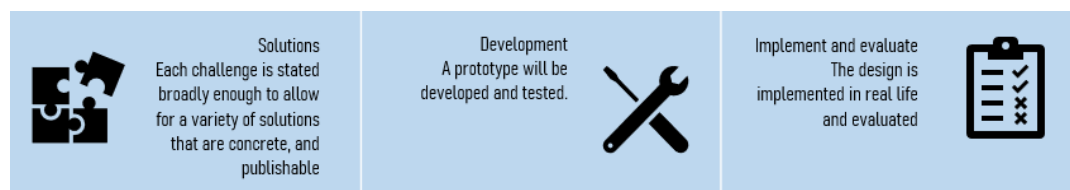


Figure 3 Phase 3 of CBL: **Act. Solutions:** Students define and design solutions, and choose the most appropriate one. In Development, students develop a prototype and test it. In the final step: **Implement and Evaluate** the design is tested in real life and evaluated on the impact it has on the challenge and society. Students also **reflect** on the whole process.

5. OUTLOOK

Based on the discussions in the five sessions, the SEG IoE would like to discuss different perspectives for the future of CBL@UT.

5.1. DESIGN OF A UT-CBL FRAMEWORK THAT INCORPORATES THE UT SIGNATURE OF CBL

As a University of Twente, we have a unique profile with interesting selling points that can be used in the development of a UT-CBL framework. Selling points include:

- **High Tech Human Touch** character of problems – give students the opportunity to work on the combination of social and technical aspects of a problem;
- The Engineering, **entrepreneurial** and/or innovative mindset of our students is a strong asset – use CBL to support students in further developing this mindset;
- **OOO: Research Design Organize.** Currently at the UT, some CBL activities make use of the Design Cycle, whereas other CBL activities focus on the research aspects. In the discussions it was mentioned that sometimes a company has a really wicked problem. In such a situation, CBL could be used to untangle all the aspects and come up with a number of follow up projects.

In the current document, the Apple Framework was used to explain a CBL process. At the moment, multiple frameworks are used to implement CBL at the UT. In some the focus is on research aspects, whereas others focus on design. As this might be confusing for both students and teachers, a UT-CBL model should be designed that incorporates our unique selling points.

Advice: Design a UT-CBL framework that incorporates our unique selling points.

5.2. RESEARCH INTO THE UNKNOWNNS

To be honest, much is still unknown about the implementation of CBL. Many questions can be formulated on the effect on students' learning, the involvement of stakeholders, the added value of implementing CBL for teachers. Questions like: *How to collaborate with companies? How to build a learning line for CBL? How to get started? How to assess? What do students learn? How to support teachers? How to relate CBL to research? What opportunities exist in connecting CBL to the research portfolio of the UT?*¹

One might consider these questions as obstacles that need to be removed (answered) before action can be taken. Another approach is the use of *Action research*. Action research can be described as a research methodology which pursues action (or change) and research (or understanding) at the same time⁶.

Advice: Perform (action) research into the unknowns, while implementing CBL.

5.3. ORGANIZE A PROJECT GROUP.

To build a strong portfolio for CBL with a UT-signature, the SEG IoE advices to give programmes the **freedom** to choose how much CBL they want to incorporate in the programme (instead of the 30% mentioned in Shaping).

Start with a couple of cross-disciplinary challenges that can be used as a strong CBL-portfolio. These CBL-activities should be designed carefully, coached during the implementation and evaluated. All those experiences can be used to extend our portfolio. The implication of this approach is that the timeline is 'beyond tomorrow'.

Advice: install a project group that coordinates the CBL-activities, develops a UT-CBL framework and develops some UT-cross disciplinary challenges.

¹ Researchers and teachers might use their (Challenge Based) research as a starting point for Challenge Based Learning. For example the research problem "micropollutants in water". One could related CBL-cased to this research problem. Of course, one needs help in redesigning these cases into CBL – but it could be a nice starting point and an educational experiment to find out the educational benefits of CBL for both the students and the researchers.

6. REFERENCES

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