# Strategising with Challenge-Based Learning to boost student's transferable competence development

# A white paper

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Universities in the Netherlands generally acknowledge that their students need to acquire so-called transferable or enterprise competencies/skills. Some examples of these skills are self-management, self-awareness, social intelligence, reasoning for complexity, digital transformation, communication, and collaboration. Future employers expect graduates to be able to continuously refresh their knowledge and apply it to new contexts; educating students to act based on this new knowledge is just as important as learning new knowledge. Therefore, universities need to create a learning environment that supports and encourages the development of these skills. Such a learning strategies and processes to train and develop such skills differ from the ones that focus on disciplinary knowledge development. Both matter, and when systematically combined and integrated at the classroom level, new opportunities arise for students to become sufficiently equipped with a set of skills which are helpful in their future careers.

A recent development to promulgate the development of such enterprise competencies is Challenge-Based Learning (CBL). As the name already implies, CBL is centered around the idea that learning is driven by the challenges the students work on. However, its implications are broader than this, and a couple of them will be set out in this document. CBL offers a framework that supports students to improve their entire learning journey by designing and guiding it, including methods/processes that promote meaningful collaboration with fellow students and external parties. It can be considered an important vehicle to create societal impact with solutions resulting from the outcome of CBL processes. In this sense, it opens up the opportunity for universities to valorize their educational efforts through the active involvement of external stakeholders, who are considered challenge providers in the jargon of CBL. Despite its potential for both transferable competence development and impact creation, there are certainly institutional barriers and other complexities to overcome, for instance the role of external parties in learning processes, the role of educators, and the need for an interdisciplinary way of working. Some of these challenges were discussed earlier on the 4TU platform (see link <a href="https://4tucee.weblog.tudelft.nl/2020/07/13/challenge-based-learning-at-the-university-of-twente/">https://4tucee.weblog.tudelft.nl/2020/07/13/challenge-based-learning-at-the-university-of-twente/</a>).

# Current status at the University of Twente

Building on the premises of CBL as a promising educational framework, the University of Twente (UT) started with a few initiatives in 2020 ahead of and in pursuit of their new vision, Shaping 2030. A related initiative is the ECIU-university project. Together with 11 EICU partners of European universities, the UT (as the leading partner) is working on the development of a European university fully dedicated to challenge-based learning and challenge-based research. CBL-based pilots have been

already conducted to test the ECIU-U-wide organization of challenges, by attracting students, engaging stakeholders as well as training educators to effectively support student teams. A few examples of these pilots are the mixed team challenges organized by Linköping University, Sweden, held in September 2020, the UT's autumn challenge held in September 2020, and the upcoming ECIU-U pilot 2 in March 2021 in which students and staff of the UT will play an important role.

In other cases, we saw that module coordinators of existing modules at the UT have started to transform their group assignments and projects into CBL assignments supported by CELT and NOVEL-T. Currently, there are two HT-HT minors that have embraced CBL as the educational framework for their group assignments. Active external stakeholder involvement, labeled as the challenge provider, is an important feature of these minors. One minor is hosted by BSM and the other by the ET faculty. Elective modules such as the HT-HT minor series pose a fruitful context to experiment with CBL since they are not bound to the program's intended learning outcomes and are usually open to students with different educational backgrounds, which enables interdisciplinary learning – a key feature of CBL.

In pursuit of the UT's new master vision, UT faculties began exploring opportunities for integrating CLB and interdisciplinary learning in master programs. CBL-driven education is being increasingly adopted and experimented with in the ITC faculty. As part of the BMS-initiated educational innovation program, we are currently working on designing a new CBL-based minor which is solely devoted to letting student teams work on local initiatives to foster entrepreneurship and citizenship in the pursuit of sustainable regional development. This list is not exhaustive; there are certainly other CBL-driven initiatives ongoing at the UT, such as the Green Hub planning to design an elective on social entrepreneurship and community involvement based on a CBL framework. At the 4TU level, a special interest group has emerged centered around enterprise/entrepreneurship education for engineers. The idea is to develop a platform for use in the 4TU context to facilitate educators (train the trainer) and program managers with designing CBL-based courses in engineering programs with the aim to create entrepreneurial engineers.

Driven by these ongoing initiatives and the emerging efforts of the UT's Shaping Expert Group, the UT will continue with its transformational efforts to implement CBL in ongoing educational programs and perhaps beyond, extracurricularly or by expanding the electives. Their change efforts should probably be directed to aligning the ongoing initiatives, developing a common understanding of CBL as a learning strategy, creating awareness among educators, and aligning with the ECIU-U.

#### The purpose of this document and our motivation

To help shape these transformational efforts and processes, we aim to share a couple of our ideas in this document. We base these considerations on our teaching and consulting experiences, our contributions to ECIU-U work packages, and the many ongoing formal and informal discussions we have had with colleagues about CBL and the transformation of the educational landscape. Raymond became familiar with CBL during a visit to Linköping University in 2018. This university integrated CBL in their project course named Ingenious many years ago. He was surprised by the level of enthusiasm among the student teams, the solutions they produced as well as the serious interest of external private and public stakeholders to support this course. Together with NOVEL-T, we started to experiment with this idea in the HT-HT minor course New Technology and Business Development and watched how the students teams took ownership of their learning process and came up with interesting solutions to challenges provided by external parties. To promulgate CBL as a potentially interesting educational framework, Raymond co-organized a 4TU CBL awareness workshop as an official starting point; it was held on January 8 on our campus.

For Leonie, CBL potentially supports all components of innovative education (student-driven learning, interdisciplinary, competence-based, flexible learning paths, and development of 21<sup>st</sup>-century skills) and at the same time provides educators with sufficient flexibility to customise the approach in a way that suits their discipline. Today, Leonie provides educational consultancy services to help educators with designing and applying the CBL approach in their modules/courses. She supports several ECIU-U pilots and was involved in extracurricular projects such as the Autumn Challenge. In the ITC faculty, she supported an existing elective: Weather Impact Analyses<sup>1</sup>. This elective adopted CBL as its framework for the team assignment. She is convinced of the potential of CBL, provided that CBL is implemented well and that enough time and resources are available for educators for an adequate adoption.

Our considerations are certainly not exhaustive, but we trust that they will provoke thought processes and – even better – may be used as a heuristic to formulate the necessary transformational strategy and steps. The first consideration deals with addressing the basic premises of CBL. The second one defines what makes a challenge suitable for CBL. The third one addresses ideas related to change at the institutional level. This consideration is significantly inspired by a case study from Tec Monterrey, Mexico.

# Consideration 1: Determining the basic premises of CBL

Universities are increasingly seeking to create societal impact with both research and education. In this regard, education is increasingly considered an important vehicle to realize such ends because student teams can work concretely on real challenges offered by society. It is certainly possible that the students can come up with valuable solutions and potentially advance technological and society development towards desired ends. However, the learning process is equally important to ensure that specific competencies and learning goals desired by the students and the program are met. The balance between the solution and the learning process should therefore be ensured in any CBL unit, whether intra- or extracurricular. So, instead of focusing on impact, we must first be conscious about what CBL is and address some of the key components of the learning process that potentially generate impact through CBL.

The following definition indicates the scope of CBL.

# Challenge-based learning takes places through the identification, analysis and design of a solution to a sociotechnical problem. The learning experience is typically multidisciplinary, involves different stakeholder perspectives, and aims to find a collaboratively developed solution, which is environmentally, socially and economically sustainable.<sup>2</sup>

Some may feel that CBL overlaps with other pedagogies that support the development of transferable competencies such as problem-based learning or case-based learning. This is certainly true to some extent at least. However, CBL has specific characteristics which makes it a pedagogy on its own:

✓ Students work on real-life wicked problems for learning purposes

<sup>&</sup>lt;sup>1</sup>Janneke Ettema, Weather Impact Analysis, June 2020

<sup>&</sup>lt;sup>2</sup>. Kohn Rådberg, K., Lundqvist, U., Malmqvist, J., & Hagvall Svensson, O. (2020). From CDIO to challenge-based learning experiences–expanding student learning as well as societal impact?. *European Journal of Engineering Education*, *45*(1), 22-37.

- ✓ The focus is on the development of so-called enterprise competencies (i.e. transferable skills in regard to self-management, self-awareness, social intelligence, reasoning for complexity, digital transformation, communication, or collaboration)
- ✓ Transferable competencies are deliberately taught/trained throughout the course/module
- ✓ Interdisciplinarity (students in the course/module with different educational backgrounds)
- ✓ Defined course/module learning goals for transferable competencies (in conjunction with learning goals of the course subject)
- ✓ Active external stakeholder engagement in the learning process (co-learners co-assessors)
- ✓ Students have the freedom to co-design their own learning paths
- ✓ Educators are coaches of teams (instead of solely providing instructions)

These characteristics are also the basis for a study conducted by master student Sahar Afzali and us. In Sahar's master thesis project, we designed a survey to determine the current level of CBL eligibility in courses/modules and the potential for change in different study programs and levels (Bachelor, Master, Minor) at the UT. Before distributing the survey to UT course coordinators, we conducted two pre-tests, one with 8 educators from Saxion and one with 2 educational specialists from CELT. Last November, 72 course coordinators (12% response rate) completed the survey about the course/module that they coordinate. Currently, we are analyzing the data in more depth, but our initial observations can be reported at this point.

Table 1 presents the results on the overall degree level (BSc/MSc). Some 48.5% of the master course coordinators scored above average on the presence of CBL characteristics in their current course/module. In comparison, the bachelor courses/modules showed only 18.8%. The same applied to the potential for change (adopting CBL features). We saw that course coordinators of master-level courses attribute a higher score on the potential to change (67.6%) in comparison to the bachelor-level ones (54.5%). However, both scores are higher than the above average score in the current state, implying a potential for change for both levels. The current state at the bachelor level scores 46.9% below average, suggesting that a long growth path is needed, despite its potential for change. It may be considered surprising that bachelor-level modules score below average on CBL-derived characteristics (and hence CBL readiness) given the TOM design principles to include project-based education and teamwork as well its focus on skill development. Currently, we are focusing on the results and as far as possible examining to what extent there is a difference between faculties and programs. Thus, we must treat the initial observations prudently.

#### Table 1

	Current state %			Potential %		
	Below average	Average	Above average	Below average	Average	Above average
Level						
Bachelor	46.9	34.4	18.8	15.2	30.3	54.5
Master	18.2	33.3	48.5	5.9	26.5	67.6
Years of experience						
low	4.2	4.3	26.1	-	20.0	11.6
medium	16.7	34.8	34.8	11.1	20.0	37.2
high	79.2	60.9	39.1	88.9	60.0	51.2

CBL readiness of UT courses categorized in bachelor and master level, indicating current state and potential

Another puzzling result concerns the relationship between CBL state/potential and the teaching experience of the coordinators. In general, we see that highly experienced teachers indicated a higher

below average score in the current stage (their courses have fewer CBL features) as well as a high below average score on the potential to change that course. Less experienced teachers, in contrast, indicated a higher CBL readiness and potential for change in the courses they coordinate. It is difficult to explain why this is the case. It may be that experienced teachers coordinate courses that are traditionally designed to focus on the content and subject of the course. Here, too, we must treat this observation with care as it certainly cannot be generalized in this phase.

Table 2 presents the mean of the constructs. It is evident that the mean for the current state is lower than the mean for the potential for change. This difference may reveal that despite the low score for the current state, coordinators in general see possibilities for innovating their course. Interestingly, enterprise/transferable skills show the largest range and highest potential, indicating the potential for the low-hanging fruit for CBL implementation in ongoing courses and modules.

We are now in the process of analyzing the data at the faculty, program, and degree level, resulting into a more finely nuanced picture. So, to be continued.

	Current		Potential		
	Mean	Std. Deviation	Mean	Std. Deviation	
Current Stakeholder involvement	2.35	1.08	2.96	1.05	
Current Flexible learning path	2.31	0.77	2.96	0.84	
Current Real-world experience	2.93	1.07	3.43	1.13	
Current Enterprise/Transferable skills	2.87	0.98	3.58	1.00	
Current Teacher role	3.03	0.75	3.36	0.84	

#### Construct readiness level for UT total

Once concluded, we will communicate the results to an interested audience and hopefully provoke an in-depth discussion on the meaning of CBL and its possible implications to transform ongoing courses and modules. In this regard, we consider the validated items used in this survey as useful ingredients to create a design tool for CLB courses.

Another related idea is to use this survey to develop a scientific tool and create a community interested in CBL at the 4TU level. For instance, it might be valuable to develop an online platform in which 4TU universities can use the survey for data collection and in so doing develop a data source for scientific purposes and benchmarking (TUe has already adopted CBL to a large extent) and to guide transformational efforts at the university level based on design tools to be developed.

# Consideration 2 : what makes a challenge suitable for CBL?

Nowadays, societies and their industries are undoubtedly exposed to many great challenges, and it is the role of universities to educate responsible students who can design methods to deal with such challenges in many areas. Universities in general should strive to create educated minds, as originally defined by Aristotle. An educated mind is capable of entertaining a thought without accepting it, whereas an uneducated mind accepts or refutes a thought without entertaining it. It will not be enough to merely encourage students to develop such an educated mind. We need frameworks that challenge their own knowledge (or lack thereof), their maturing world views as well as their routes of action and consequences. A key aspect of CBL is that the students work on a real-world problem from which they derive their own challenge and create their own solution in collaboration with the external stakeholder. Basically, a challenge must fulfill the following criteria: it should be wicked enough, implying that the issues present great economic, political, social, ethical and technological complexity, and it must be difficult to explain and inherently have no solutions readily available.

So, unchallenged goals will lead to unchallenged solutions, and this will undermine the essence of CBL and be detrimental to learning performance and competence development. Any challenge – even if it is introduced as "wicked" – is not suitable for CBL if it already implies a solution. In that case, the students are not challenged sufficiently to explore solutions themselves. The so-called sustainable development goals (SDGs) presented by the UN are examples of such challenges. Each of these 17 goals is certainly ambitious and poses "a challenge" to the world. Combatting climate change, the need for resilient cities and communities, no poverty, no waste, no hunger, and reducing the inequalities in the world are indeed unquestionably noble causes. However, these goals are fixed and can hardly be disputed, which makes them less suitable for CBL. More problematic is that the general solutions are already provided in the SDGs, and this certainly narrows the boundaries within which the student teams can explore novel solutions. In other words, it will undermine the 'out of the box' level of thinking which is important in the first phase of the learning process in CBL.

For CBL, the more wicked and controversial the problems or ideas are, the better it is for the students because they are triggered to challenge their own world views, set creative processes in motion and come up with their own solutions. This certainly does not imply that challenges and solutions should not be assessed by sustainability or ethical standards. The students should explore in depth and carefully which stakeholder is affected by the challenge and the solution as part of the learning process. The SDGs refer to solutions to world problems. Given this comprehensive scope, it is certainly a huge stretch for any student team as well as external parties to do the translation from world problems to regional/stakeholder problems, or the other way around. The time is usually limited to a couple of weeks or the duration of a module, so only partial solutions can be offered, which may lead to frustration among the students in a sense that they may perceive it as a drop in te ocean.

Given the commitment of the UT to the SDGs and its programs, it remains possible to link the solutions explored by the students to one of these SDGs or any other national/ sustainability goal in whatever domain.

## Challenges and challenge providers

After a couple of years of experience in selecting challenges from external stakeholders, we have encountered a few challenges ourselves in selecting the right challenges. Some are too narrow, too obvious, too ambitious whilst others focused on testing solutions. External stakeholders are certainly willing to revise their big idea/problem in such a way that it is suitable for CBL whilst still being committed to collaboration. Shifting their orientation to the future will sometimes help us to arrive at a more complex and challenging level of their problem, which makes it even more strategic and interesting for them. Some may therefore say that CBL operates at the fuzzy front end of the innovation journey, but this need not always be necessarily true. However, if their question remains too specific or urgent, it is not suitable for CBL, but there are always other opportunities to link their assignments to courses and thesis projects.

Ensuring commitment from the stakeholders is critical in CBL. Active stakeholders are the ones who offer all kinds of wicked problems and big ideas from which they and the students derive workable challenges to learn about and to produce solutions for. In contrast to existing educational practices with stakeholder involvement, CBL requires sufficient preparatory work. It involves not only defining a

problem/idea suitable for CBL but also the ability to manage the expectations up front to ensure stakeholder commitment throughout the entire learning process.

# Consideration 3: Seeking "the low-hanging fruit" in transforming educational practices

## Tec Monterrey (Mexico) as Benchmark

What can we learn from others in transforming the educational model? An exceptional example of a university that managed to adopt a university-wide CBL framework is Tec Monterrey in Mexico. They managed to find a critical balance in the competence development of their students on the one hand while producing solutions for external parties on the other. In November 2020, I had the opportunity to interview Beatrix Palacios (Director of Educational Innovation). Below is a summary of this meeting.

In attracting new students, Tec positioned itself as the university for gaining necessary skills for successful career development by being more strongly connected to the real world and offering more flexibility (learning paths), from industrial education to personalized education. It emphasized the development of 21st century competencies in the students rather than the creation of the societal impact that they wish to make, which they conceive of as a by-product of CBL. Five years ago, Tec reassessed all their courses/modules in existing programs to get an overview of the competencies developed. Then they implemented learning activities and assessment practices based on CBL to bolster competence development and gradually worked on an overall CBL framework at 31 campuses. An important part of this effort was to align all the competencies into competence profiles and learning paths. Regardless of the discipline and profile, all students start at a novice level and achieve an advanced level at the end of their study. To graduate, the students must follow a course and a CBL project in a different educational program. This ensures that the students acquire advanced competencies in an interdisciplinary setting due to collaboration with students with different educational backgrounds. In general, CBL projects vary from short ones up to longer ones of one semester. The balance between content knowledge and competencies is 50/50 in most of the courses/programs. In sum, Tec considers CBL as a means for competence development, with skills that are systematically developed and assessed through learning paths. To account for the competencies developed in light of the career demands of the students, each student is assigned one tutor who remains their contact person throughout their entire stay at Tec. A tutor supervises and monitors approximately 200 students at any given moment.

#### Top-down initiated incremental change

Tec's guiding transformation philosophy was to begin with the so-called low-hanging fruit. They first started with looking at the competencies already developed in existing courses and modules. Then they gradually involved professors by training them in re-designing their courses to strengthen competence development by adopting CBL principles and altering assessment practices while being supported by Tec's educational professionals. At the same time, the professors strengthened their relationships with external parties as a necessary requirement for CBL. The course content remained untouched for the time being since the focus was on competence development in group assignments. This exercise already led to an increase in the number of CBL units across their 31 faculties and campuses, which could then be expanded into more interdisciplinary courses and learning paths for the students to choose from. The transformational efforts were tough since many educators initially experienced that their role was downplayed by this new educational model. Nowadays, Tec accepts

that not all educators are willing or able to run a CBL course/module but prefer to teach in front of a classroom. Scaling monitoring, assessment systems and routine development were considered important to account for a solid, auditable educational quality level and stakeholder management. The idea was thus to make use of existing infrastructures, resources and their set of external educational partners that they had always worked with. The change strategy was top-down but incremental nonetheless, instead of radical. Nowadays, Tec works routinely with external stakeholders (e.g. challenge providers and usually larger companies in Mexico and Europe). Practitioners from external partners sometimes join courses/modules and collaborate with student teams during their challenge. External parties are eager to work with Tec because they reap the benefits of students thinking out of the box, which contributes to the fuzzy front end of their innovation strategies. All in all, it took Tec five years to entirely transform their educational model. This explains the substantial amount of literature written on institutional strategies for developing enterprise education in a higher educational context.

# Ideas to reach the goal

The spontaneous developments regarding CBL at the UT so far can be regarded as bottom-up initiatives brought about by some pioneers. This will not be enough to meet the goals in the Shaping 2030 vision: 30% of the educational offer should be based on CBL and realized by two years from now. This includes a dedicated CBL-driven master. Since expansion is not the main purpose, the focus will likely be on alignment with ongoing bottom-up initiatives used as examples and embedding CBL in the educational landscape of the UT. There are two ideas related to the latter. Both ideas are presented separately for the sake of clarity but can also be combined.

## 1. Relying on ECIU-U to reach the shaping goal

In its development and plans, the ECIU-U intends to offer multiple CBL projects of different durations in the future (nano, mini, standard, strategic challenges). In this sense, it can and will be the UT's educational partner in providing CBL projects/courses to UT students as well as students from ECIU-U joint venture partners. However strategically sound this alignment between the future ECIU-U programs and the study programs offered by the UT is, serious consideration has to be given to the issue of being the UT's sole supplier for CBL. In pursuit of Shaping 2030, we assume that the UT will offer all its students CBL-based competence learning paths aligned with their study programs.

- In that case, the EICU-U needs to offer CBL programs on a routine basis to enable planning and the systematic development of student's competence profiles.
- Apart from planning issues, the integration of these CBL programs/units in ongoing curricula and programs may pose challenges, especially to link the content of the course in the study program to the challenge at hand and the competencies that particularly the ECIU-U unit offers.
- The EICU-U must make sure that the students are sufficiently trained and coached in the competencies that they want to develop during a challenge.
- Sufficient assessment practices must be in place to attest for the transferable competencies developed. These competencies need to be aligned with the set of transferable competencies defined by the program (program-specific learning goals) of each UT study program and become integrated in the assessment policies of all of the UT's programs. We can benefit from our experience with setting up double-degree programs if this idea is favored.

These are just a few considerations, and we are sure that numerous other ones will show up once this idea is explored in more depth. For instance, to what extent is the EICU-U able or willing to tailor their CBL programs and units/events to the needs of the UT since there are 11 more joint venture partners to take into account?

# 2. Reaching the shaping goals through top-down initiated change

Another way to develop CBL-driven competence learning paths and reach the shaping goal of 30% is to transform our own educational landscape, especially since there are already many faculty-led ideas and initiatives ongoing. Not all of these initiatives focus on the implementation of CBL per se but at least they concentrate on competence development and interdisciplinarity. Indeed, there might be a drive to embed CBL more strongly in ongoing study programs as well as those that are in the process of being redesigned. Here are some ideas about this sequence of transformation.

- Communication about CBL. CBL is not a totally new educational model to replace others. It
  must be considered a framework that allows us to strengthen and professionalize ongoing
  initiatives to bolster the development of transferable competencies. The survey sample
  results reveal that we are halfway, which is not really surprising given the level of case-driven
  projects and teamwork in existing courses and modules. Presenting it as totally new would
  probably alienate staff and cause unnecessary resistance to change.
- Harvest the low-hanging fruit. We consider the current HTHT minor series as a preferred starting point for CBL adoption. Three modules (100 students) in this series have adopted CBL already. The reasons are: a substantial amount of group work in these modules, a close link to practice, and accessibility for students of all educational backgrounds. The last aspect enables interdisciplinary learning, probably the most challenging key feature of CBL when it comes to implementation.
- Start with an inventory of the type of transferable competencies that are explicitly or implicitly acquired by students in ongoing courses/modules. Some are obvious and easy to retrieve due to the number of formative assessment practices and the presence of group work, while others are not. Mapping the transferable competencies provides a broader overview of what the UT already does when it comes to the development of such competencies. For example, mapping competencies is already practised in the IBA program as part of a project supported by the BMS education innovation program.
- After this, the efforts can be directed to redesigning the course components responsible for competence development into a CBL framework and constructively aligning learning goals, learning activities and assessment practices in that course. Course objectives are extended with competence goals without undermining the program's intended learning outcomes. Educators will need to be trained to redesign and facilitate CBL while being supported by CELT staff at the same time.
- With the insights of the competencies developed at the course and program level, it now may be possible to draft learning paths for specific competence profiles that students can pursue.
- To scale up and offer interdisciplinary learning, learning paths need to stretch across existing and redesigned study programs (possibly combined) and levels. At the UT there are a few combined programs, but most of them are largely monodisciplinary, with the majority of

students within the same study program. The development of such learning paths may present the most challenging part of the change actions as it certainly poses implications for program management, examination boards, educational and supportive staff.

• External parties as educational partners are a very important asset in CBL. So, I would suggest strengthening relationships with external parties as future challenge providers (educational partners) who recurrently bring in new wicked ideas and challenges. At the strategic level, we may be in need of a strategy to engage and develop long-term relationships with regional partners especially for educational purposes. Furthermore, many educators do already have a network of external public and private parties and also partake in their courses. With these warmer contacts, these parties can be mobilized for stronger involvement in their courses by bringing in wicked problems and reaping the benefits of the solutions provided by students. This will certainly enhance their commitment over time. Thus, even if not all CBL requirements and conditions are met yet, it is good to start with intensifying the relationship with external partners in courses and modules in the spirit of CBL and get acquainted. Here, relationship and expectation management are key.