The CBL Continuum
a Tool for CBL Implementation

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Implementing CBL, as illustrated through the cases in this book, can be exciting and rewarding. However, it can also be overwhelming as designing education, particularly when incorporating CBL elements, is a wicked problem in itself. There is no one-size-fits-all approach to applying CBL, and it requires a well-planned and thoughtful execution to maintain the balance of ongoing education.

To assist teachers and educational designers in transitioning to fully realised CBL courses, we—a team with expertise in educational science, educational research, and CBL teaching from the University of Twente—have proposed a conceptual model, the CBL Implementation Continuum (Imanbayeva et al., 2023). The model connects CBL elements to the Curricular Spider Web of Van den Akker (2003), reflecting curricular alignment, consistency, and coherence. The Spider Web compares a curricular design to an intricate and interconnected web. The learning rationale is the key link in the web, and the threads extending from it are the other significant components of a curriculum, such as learning aims and objectives, content knowledge, learning activities, teacher role, materials and resources, grouping, location, time, and assessment (Van den Akker, 2003). This model illustrates how each aspect of a curricular design is interrelated and impacts the overall educational experience.

For each curriculum component, we introduce varying levels of CBL intensity—Mild, Moderate, and Intense—providing a flexible framework to cater to diverse educational needs and preferences. The Mild level describes how CBL essentials can be initially integrated into the existing educational structures. Building on this, the Moderate CBL introduces additional CBL elements, providing a more comprehensive CBL experience. The Intense level describes a full-scale implementation of CBL, where all the elements of CBL are integrated into the curricular design. We will now explore how each spider web component unfolds across the continuum. You can find a visual overview of the model on the University of Twente website at this link: https://challengeup.utwente.nl/.

Learning Rationale

The learning rationale explains why students learn in a curriculum. In CBL, students learn to positively impact society and interact with the real world (Apple Inc., 2011; Conde et al., 2020; Cruger, 2017; Nichols et al., 2016). At the Mild CBL level, students tackle wicked societal problems passively, focusing on engaging with the problem, investigating it deeply, and advising relevant stakeholders. The Moderate level deepens students' engagement by linking the big idea to something personally relevant to the students and requiring a more active real-world impact. At the Intense level, students' actions have direct, measurable effects on the challenge and stakeholders they worked with.

Learning Objectives

Learning objectives in CBL guide students towards identifying and filling their knowledge and skill gaps for personal development (Apple Inc., 2011; Nichols et al., 2016). In Mild CBL, learning objectives are still teacher-defined, but already incorporate CBL elements by facilitating students' reflections on their knowledge and skill gaps and fostering a more mindful learning experience. At the Moderate CBL level, learning objectives expand to encompass higher-level objectives along with 21st-century skills development and require students to define some personal learning objectives, offering students more personalised learning options and promoting ownership. In Intense CBL, students independently set their learning objectives, tailoring the learning path to their ambitions and interests. Teacher-defined learning objectives are abandoned at this

level. Instead, teachers facilitate students in defining their own learning objectives.

Content Knowledge

CBL content knowledge includes transversal skills and interdisciplinary academic knowledge crucial to students in designing solutions for their defined challenges (Apple Inc., 2011; Dieck-Assad et al., 2021; Nichols et al., 2016). At the Mild level, students create a knowledge repository that merges interdisciplinary academic knowledge with 21st-century skills mainly defined by the course. However, they are also encouraged to explore other topics relevant to their challenge. When progressing to Moderate CBL, the focus equally balances content pre-defined in the course and content related to the challenge. At the Intense level, the content knowledge shifts completely to prioritising challenge-specific knowledge, incorporating multiple disciplines. Pre-defined content is limited at this level.

Learning Activities

CBL learning activities engage students with wicked societal problems, guiding them through defining, investigating, and addressing actionable real-world challenges (Apple Inc., 2011; Dieck-Assad et al., 2021; Gallagher & Savage, 2020; Leijon et al., 2021; Malmqvist et al., 2015; Nichols et al., 2016; Yang et al., 2018). In Mild CBL, the learning activities are strictly scheduled and focus on understanding concepts, collaboratively identifying actionable challenges, working with stakeholders, and encouraging reflection on solution designs and their potential impacts. The Moderate level increases student autonomy, promoting independent stakeholder engagement and requiring students to implement their solution designs. The reflection becomes more profound at the Moderate level as students are required to reflect cyclically. At the Intense level, learning activities become even more personalised. Students are encouraged to connect deeply with the big idea and form groups based on interests. The solution must not only be implemented but its impact should also be actively evaluated, with a cycle of documentation for broad dissemination of results. Students decide which learning activities are needed to achieve this.

Teacher Role

As CBL is a student-centred framework, the teacher role shifts from the ultimate knowledge facilitator to a coach and an advisor (Chanin et al., 2018; Dieck-Assad et al., 2021; Nichols et al., 2016). At the Mild level, teachers guide the learning process as supervisors and provide expertise as professional advisors. Moving to Moderate CBL, they transition to coaches, emphasising active facilitation and encouraging students to lead their learning journey. At Intense CBL, teachers collaborate closely with students as co-learners, co-researchers, and co-designers, creating a dynamic environment for mutual knowledge exchange.

Materials and Resources

Students are expected to leverage a variety of (guiding) resources and advanced technology to create innovative solutions and boost digital literacy (Apple Inc., 2011; Gallagher & Savage, 2020; Gibson et al., 2018; Nichols et al., 2016; Pepin & Kock, 2021; Tang & Chow, 2020). In Mild CBL, students mainly use resources provided by the teacher and are encouraged, but not mandated, to explore additional materials. At the Moderate level, students are given more autonomy in choosing the resources, while using technology becomes mandatory, and teachers are expected to provide access. In Intense CBL, students should have access to cutting-edge technology to develop advanced digital skills and prepare for the digital world. Students determine which materials to use based on their defined challenge.

Grouping

CBL grouping focuses on assembling students from varied backgrounds to encourage a broad interdisciplinary perspective on a challenge (Dieck-Assad et al., 2021; Gallagher & Savage, 2020; Nichols et al., 2016). In Mild CBL, diverse groups are formed that bring together students from various academic, social, and cultural backgrounds. The teacher plays an important role in forming these groups by, for example, providing guidelines and establishing rules. At the Moderate level, students are specifically required to form multidisciplinary groups encompassing students from different disciplines. At the Intense level, a CBL group includes coaches

(teachers) and stakeholders, in addition to students from different disciplines, where everyone is a learner, and the students are in the lead. Group composition at this level depends on the challenge, and there are no pre-defined rules for group formation.

Location and Time

A CBL experience 'extends the classroom environment and necessitates access to the real world' (Nichols et al., 2016, p. 19), encouraging learning flexibility and student autonomy (Nichols et al., 2016). Thus, Mild CBL location and time require students to learn in real-world settings, which could include visiting sites, interviewing stakeholders, and attending lectures by experts. However, the course structure still involves a set of planned, mostly compulsory activities such as rosters. As the course progresses to Moderate CBL, there is a shift towards more flexibility in scheduling and location. Some lessons become voluntary, and more room is given to self-directed learning activities. Teachers support this by providing physical spaces for transitioning between individual and group activities and through virtual platforms for continuous collaboration and resource sharing. The Intense CBL level fully embraces flexibility, giving students the autonomy to choose when and where to engage in learning. It is supported by unfettered access to collaborative learning spaces and stimulates real-world learning.

Assessment

CBL assessment prioritises the learning process and reflections over the product or content mastery. Solutions to challenges are evaluated, focusing on the design's integration of knowledge and feasibility (Gallagher & Savage, 2020; Nichols et al., 2016; Yang et al., 2018). Assessments involve students, teachers, and stakeholders as co-assessors (Cruger, 2017; Nichols et al., 2016). In the Mild CBL level, both the innovation of the product and the reflective aspects of the process are evaluated based on criteria for knowledge integration and feasibility. There is still a significant focus on assessing content at this level. Moving to Moderate CBL, the focus shifts more towards creativity and the process, with students critically reflecting on the outcomes and playing a role in assessment decisions. Content and process are more or less of equal importance. At the Intense level, emphasis is on personal progress

and decision making, with students fully participating in co-assessment, promoting a collaborative evaluation of their learning journey.

Using the Continuum

The intensity levels of CBL provide teachers with the flexibility and direction needed to design a CBL course. Rather than implementing CBL all at once, transitioning to CBL step-by-step is valuable to ensure a well-planned and systematic approach, keeping the functional components of the curricula intact and reducing work pressure. Another important reason is the consideration of whether students are ready for CBL. Have they had prior academic experiences that have prepared them for Intense CBL? Are they comfortable with group work and able to handle the complexities of a multidisciplinary CBL group? Have they had any experience working with external stakeholders? Do they possess the skills to convince experienced professionals to follow their lead? Adopting the CBL mindset requires students to be committed to exploring, innovating, and actively participating in the world around them. Answering these questions can help teachers decide on the appropriate CBL intensity level.

One may now wonder how to use the continuum to choose the appropriate intensity level for course design. The key is ensuring that the CBL design aligns with the broader learning objectives of the course. Asking why CBL is being incorporated into the course design can determine the appropriate intensity levels for each component and the course holistically. For example, if the goal is to teach students how to have an impact, the CBL Learning Rationale should be at the Intense level. This will help students truly connect to their big idea and the challenge, work towards immediate societal impact, and actively interact with the real world. As such, it is important to frequently reflect on how CBL benefits a course and fosters students' growth. It is crucial to remain open to changes in course design when necessary and when the time is right.

Incorporating CBL into higher education is a gradual process that aims to build on existing educational practices and may transform the educational landscape. This process requires careful planning, efficient execution, and continuous revisions. To support a seamless and effective transition, we have developed Challenge Up, an online tool co-funded by the 4TU.Centre for Engineering Education (University of Twente). Challenge Up is designed to help teachers apply the CBL Implementation Continuum and provides a comprehensive database of best practices for

gradually transitioning to higher levels of CBL intensity. The tool enables users to specify their current and desired CBL levels for each curricular component, giving them the freedom to decide which intensity levels are most appropriate for their specific case. Based on the input, the tool generates personalised, evidence-informed advice on how to bridge the gap and attain the desired intensity level. The tool also encourages users to provide feedback, which will be used to improve the content continually. Challenge Up is accessible through the University of Twente's Centre of Expertise in Learning and Teaching website.