A3.3, O6: Scientific publication

Co-funded by the
Erasmus+ Programme
of the European Union

This document has been developed during the pilot phase of the ECIU University Erasmus+ project between 2019 - 2022.

Beneficiaries

- Aalborg University, Denmark
- Dublin City University, Ireland
- Kaunas University of Technology, Lithuania
- Linköping University, Sweden
- Tampereen Korkeakoulusäätiö sr, Finland
- Hamburg University of Technology, Germany
- Universidade de Aveiro, Portugal
- Universitat Autònoma de Barcelona, Spain
- University of Stavanger, Norway
- Universita degli Studi di Trento, Italy
- University of Twente, The Netherlands
- Institut National des Sciences Appliquées, France

Abstract

The alliance seeks to share the implemented activities and achieved results and outcomes of the ECIU University. The relevant target group for disseminations were stakeholders related to the ECIU University in the European Education Area and globally, addressing Higher Education Institutes and partners as well as the general public. We are convinced that the challenge-based approach and pedagogy as conceived and developed by the alliance can be adopted as models by any university alliance and applied to any societal question.

In this deliverable report, scientific contributions from authors of ECIU university members addressing the challenge-based approach and pedagogy within the five challenge-cycles during September 2020 and August 2022 were summarized. This report lists scientific contributions as publications and papers shared through active participation in conferences.

Table of Contents

Symbols, abbreviations and acronyms

AAU	Aalborg University, Denmark
CBL	Challenge-Based Learning
DCU	Dublin City University, Ireland
EC	European Commission
ECIU	European Consortium of Innovative Universities
INSA	Institut National des Sciences Appliquées, France
KTU	Kaunas University of Technology, Lithuania
LiU	Linköping University, Sweden
TAU	Tampereen Korkeakoulusäätiö sr, Finland
TUHH	Hamburg University of Technology, Germany
UA	Universidade de Aveiro, Portugal
UAB	Universitat Autònoma de Barcelona, Spain
UiS	University of Stavanger, Norway
UNITN	Universita degli Studi di Trento, Italy
UT	University of Twente, Netherlands

1 Introduction

The alliance seeks to share the implemented activities and achieved results and outcomes of the ECIU University. The relevant target group for disseminations were stakeholders related to the ECIU University in the European Education Area and globally, addressing Higher Education Institutes and partners as well as the general public. We are convinced that the challenge-based approach and pedagogy as conceived and developed by the alliance can be adopted as models by any university alliance and applied to any societal question.

The best practices and outputs of the Innovation of Education Labs and five cycles of challenges between September 2020 and August 2022 were shared beyond the alliance in diverse ways, including but not limited to the dedicated ECIU University website (www.eciu.org), social media channels (e.g., Twitter @ECIUuniversities, https://www.facebook.com/eciuorg/, https://www.linkedin.com/company/eciu) and encouraging study visits of and to other European universities, during events, seminars and workshops that were organised (see deliverable report 3.3O3 conducted teacher training month23), and by working together with other university alliances and stakeholders.
Here, scientific publications and conference papers shared through active participation in conferences are summarized.

All dissemination activities and especially the scientific publications and conference participations aim to:
▪ promote and raise awareness about the role of universities in the region and in society: how the ECIU University seeks to address and solve societal challenges through a joint innovation ecosystem;
▪ mainstream challenge-based education in Europe and as such fostering competitiveness of the European education;
▪ inform about scalability of the concept, transfer of good practices to other university alliances and stakeholders so that they can apply and adapt the results and outcomes of the project;
▪ build a community for challenge-based education and research, also linking to other projects and networks to create an expert niche.

2 Objectives

In this deliverable report, scientific contributions from authors of ECIU university members addressing the challenge-based approach and pedagogy within the five challenge-cycles between September 2020 and August 2022 were summarized. This report lists scientific contributions as publications and papers shared through active participation in conferences.

3 Scientific contributions addressing challenge-based approach and pedagogy within ECIU

The scientific contributions in this report are divided into three chapters. Chapters 3.1 and 3.2 present conference papers that next to their presentation at conferences are or will be part of conference proceedings and chapter 3.2 summarizes publications in scientific peer-review journals. All scientific contribution in this chapter focuses on the implementation of CBL in one of the ECIU member as best

practice description. Chapter 3.3. displays two papers, both still under review and not published, which present data investigating the implementation of CBL in ECIU University as a transnational network. For all contributions of which I had access to full text a short summary focusing on the importance for ECIU is given.

3.1 Conference papers within ECIU from the perspective of one alliance member

Here, papers that undergo blind peer-review process and that are or will be published in conference proceedings are summarized. A full list of conference contribution addressing challenge-based approach and pedagogy within ECIU could be found in final report of WP9.4.

3.1.1 Conference papers from Linköping University, Sweden

The following conference papers were presented and published:

Gunnarson, Svante; Swartz, Maria (2021): APPLYING THE CDIO FRAMEWORK WHEN DEVELOPING THE ECIU UNIVERSITY. In: Jens Bennedsen, Kristina Edström, Maria Sigridur Gudjonsdottir, Ingunn Saemundsdottir, Natha Kuptasthien, Janne Roslöf and Angkee Sripakagorn (Hg.): Proceedings of the 17th International CDIO Conference. 17th International CDIO Conference. Chulalongkorn University and Rajamangala University of Technology Thanyaburi, 21-23 June 2021. p. 106–115. Online http://www.cdio.org/knowledge-library/documents/applying-cdio-framework-when-developing-eciu-university , last check 22.08.2022.

> Special attention is given to the connections between CBL method, the conceive-design-implement-operate (CDIO) sequence and project-based learning, which is central in the CDIO framework. CBL has also been related to the CDIO framework, which has been used at Linköping University since 2006 and there are several similarities between these approaches. The paper presents both general aspects and examples of the applications and activities within ECIU University and Linköping University.

Norrman, C., Lundvall, C., Eldebo, K., Boierts, S. and Stel, F. (2022) MAKING GOOD CHALLENGES GREAT – ENGAGING EXTERNAL PARTIES IN CBL-ACTIVITIES. In: Proceedings of the 18th CDIO Conference in Reykjavik, Iceland, 13-15 June, 2022. download: https://cdio2022.ru.is/ , https://rafhladan.is/

> The contribution analyses the CBL-approach from the challenge provider perspective and provide knowledge on how to work with external parties in university courses and events and to share their experiences and provide advice on working with CBL. For the paper, two courses were investigated: (1) The ECIU InGenious - cross disciplinary project course (799G52) – that comprises 8 ECTS credits and is run twice a year at Linköping university in 6 cooperation with Almi East Sweden AB since 2016. In total, about 250 students and 58 challenge providers have been involved; (2) The Fujifilm challenge, that is part of the project ScaleUp4Sustainability and which is an Erasmus+ project (Reference number: 601150-EPP-1-2018-1-DE-EPPKA2-KA). Based on their experiences, the size of the challenge provider does not seem to be a crucial factor. Instead, it seems to be about engagement and the Challenge provider's ability to let the course team develop their idea from their prerequisites. They found that the most desirable reason for participation of an external partner is to engage in order to acquire new insights, ideas and solutions irrespective of whether it will lead to commercialisation or not.

Eldebo, K., Lundvall, C., Norrman, C. and Larsson, M. (2022) How to Make Good Teachers Great in Challenge-Based Learning. In: Proceedings of the 18th CDIO Conference in Reykjavik, Iceland, 13-15 June, 2022. download: https://cdio2022.ru.is/ , https://rafhladan.is/

> The main finding of this contribution is that for CBL to work, three main roles are required: (1) the teacher role, which is knowledge-oriented; (2) the role of the coach, which is oriented toward skills; and (3) the role of the organizer, which is oriented towards the context in which the learning takes place–the challenges. Experiences described in this paper come from two CBL projects: an internal pedagogical project financed by Linköping University and the EU ERASMUS+ project ScaleUp4Sustainability as well as an interview with a CBL teacher active within the ECIU community. One of the most important strengths of CBL seems to be that it simulates real work-life situations for students in a way that more traditional teaching never does. Although, students might find the way forward unclear, the criteria for grading vague, or the demands for subject-specific knowledge demanding. Teachers have adapted to this ambiguity by setting time and resources for coaching, feedback sessions and other types of support for the student teams. Because CBL pedagogy puts a higher demand on teams being fully functional than other courses do, authors suggested teamwork among teachers could be beneficial since this kind of learning approach requires that the teachers can take on different roles that could hence be difficult to manage for a single individual. They summarize their experiences that from a teamcher's perspective, CBL can be seen as both demanding, especially regarding resources, and rewarding. So, their recommendation is to start small and add on until a full CBL setup is reached.

Accepted but not published yet:

Gunnarson, Svante; Swartz, Maria (2022) On the connections between the CDIO framework and challenge-based learning. SEFI Annual Conference, 2022.

Eldebo, K., Norrman, C., Larsson, M. and Lundvall, C. (2022) Make Challenge-Based Learning less challenging, SEFI Annual Conference 2022.

3.1.2 Conference papers from University of Twente

Chapel, L., Petrova, N., Tsigki, E., Buunk, L., & van den Berg, F. M. J. W. (2021). Creating the conditions for an online challenge-based learning environment to enhance students' learning. In H-U. Heiß, H-M. Järvinen, A. Mayer, & A. Schulz (Eds.), *Proceedings SEFI 49th Annual Conference 2021: Blended Learning in Engineering Education: challenging, enlightening – and lasting?* (pp. 721-735)

> Authors report about their experiences from the Autumn Challenge Programme that was offered fully online as best practice. They identified some limitations, for example the lack of structure sometimes seems far outside the comfort zone of students and teacher. In their suggestion they focus on CBL course design, formulation of learning outcomes and the teacher as coach.

3.1.3 Conference papers from University of Stavanger

Accepted but not published yet:

Shahverdi M.; Pattamawan Jimarkon P.; Kenan Dikilitas K.; (2022) Dimensions of Engagement beyond the classroom in Challenge-based learning. In: *European Society for engineering education Conference (SEFI), 19-22 September 2022, Barcelona, Spain*

3.2 Scientific contributions within ECIU from the perspective of one alliance member

3.2.1 Scientific paper from University of Trento

Scroccaro, A. and Rossi, A. (2022), "Self-Directed Approach as an Opportunity to Learn in Challenge-Based Learning (CBL). A CBL Experience With Cross-Disciplinary Learners at the University of Trento", Vilalta-Perdomo, E., Membrillo-Hernández, J., Michel-Villarreal, R., Lakshmi, G. and Martínez-Acosta, M. (Ed.) *The Emerald Handbook of Challenge Based Learning*, Emerald Publishing Limited, Bingley, pp. 227-249. https://doi.org/10.1108/978-1-80117-490-920221010

The paper summarizes the experiences in assessment and self-directed approach in the Healthcare Fund Challenge conducted by University of Trento. It was a 6-week CBL extracurricular initiative that took part in spring 2021 in the context of the ECIU University with a non-profit local integrative healthcare fund and 15 students from three different universities. The assessment tools were composed of Learning agreement, learning diaries, peer evaluation and reflection reports as formative assessment and a final project presentation at the end of the challenge as summative assessment.

The first lesson is that students have to be accompanied and supported by the instructor in the new assessment approach from the very beginning if they are not familiar with educational formats which call for being responsible for their learning and assessment. The second lesson is that explanation of the new assessment structure has to be done at the very beginning of the initiative and the instructor has to guide the class in the reaction of the learning contract in order to answer all questions and to provide clarification and motivation. The third lesson learned is the need to build more structured assessment scaffolding aligned with the learning pathway, but in the same time not to overburden the students' workload. The fourth lesson learned is that the challenge provider should be supported and trained more to be involved in the assessment.

3.2.2 Scientific paper from Hamburg University of Technology

Mayer, G., Ellinger, D. and Simon, S. (2022), "Involving External Partners in CBL: Reflections on Roles, Benefits, and Problems", Vilalta-Perdomo, E., Membrillo-Hernández, J., Michel-Villarreal, R., Lakshmi, G. and Martínez-Acosta, M. (Ed.) The Emerald Handbook of Challenge Based Learning, Emerald Publishing Limited, Bingley, pp. 325-344. https://doi.org/10.1108/978-1-80117-490-920221014

The findings presented suggest that roles and functions of external partners are various: they may come into play as a *training partner*, as a *challenge provider*, as an *expert in the field* and/or as a *feedback provider*. They may take over several roles at the same time or just one out of the possible ones; they may be defined as part of the team of learners or join in at special occasions only. While there are certain advantages unique to having external partners, some roles may also be covered without (permanently) involving external stakeholders. In any case,

working with external partners requires continuous communication and negotiation regarding role-expectations, positions, and activities throughout the process. To facilitate this, the publication introduces a model to systematically analyse and balance interactions with external partners.

3.2.3 Scientific papers from Kaunas University of Technology

Gudonienė, D.; Paulauskaitė-Tarasevičienė, A.; Daunorienė, A.; Sukackė, V. A (2021) Case Study on Emerging Learning Pathways in SDG-Focused Engineering Studies through Applying CBL. *Sustainability* 2021, *13*, 8495. https://doi.org/10.3390/su13158495

The paper address Sustainable Development Goals through Challenge-Based Learning in engineering study programs. During the run of the CBL course it was noticed that the essential questions could be grouped into the following three target groups: CBL-methodology related questions, technical questions, and subject-related questions. The first phase, the engagement phase, was experienced as the most critical and most challenging one. To integrate challenge-based learning at the study module successfully the teacher has to rethink and redesign the study process. Moreover, at this stage, there is a need to combine the study module's learning outcomes with a challenge. Secondly, the challenge owner plays the key role in the creation of the challenge and its description and has to work closely with the teamcher. Finally, the results show that the participants (i.e., students) generated sustainable solutions (potential business) ideas that aimed to resolve local, national, and global problems related to the SDG 11. Furthermore, students received recommendations to continue working on their prototypes and to take them to further Technology Readiness Levels (TRLs) (e.g., TRL 5), which allow us to more clearly estimate and indicate the maturity of technologies during the acquisition phase of a program.

3.3 Scientific paper addressing challenge-based approach and pedagogy within ECIU as a transnational network

The following two scientific papers were submitted and are under consideration as well as peer-review for publication. Both papers address the ECIU university as transnational network and combines the experiences, knowledge and expertise of several ECIU alliance members.

Sukackė, V.; Pereira de Carvalho Guerra, A. O. ; Ellinger, D.; Carlos, V. ; Gaižiūnienė, L.; Petronienė, S.; Blanch, S.; Marbà-Tallada, A.; Brose, A. (202X) "Towards Active Evidence-Based Learning in Engineering Education: A Systematic Literature Review of PBL, PjBL, and CBL.

The manuscript has been submitted online and went through peer review. It was accepted for publication with revisions. Revisions were submitted on October 17th . Presently, it is being given full consideration for publication in *Sustainability* with manuscript ID: sustainability-1965990.

By conducting a systematic literature analysis of 177 scientific papers about research on Problem-, Project-, and more recently, Challenge-based learning, the paper aims to shed more light on the different steps of instructional design in implementing the three methods. Based on the analysis and synthesis of empirical findings, the paper explores the instructional design stages according to the ADDIE (Analysis, Design, Development, Implementation, and Evaluation) model and provides recommendations for teachers and practitioners. From the

pedagogical side, more studies are needed to better understand and improve teachers' as instructional designers' skills, esp. when the interventions in engineering education need to be enhanced with ICTs. Papers analysed in the review rarely report on enhancing teaching/learning with other technology than software needed for performing tasks related to engineers' day to day practice.

Ellinger, D. and Mayer, G (202X) Benefits, Barriers and Supporting Factors in Implementing Challenge-Based Learning in a transnational alliance of 12 European higher education institutions.

Manuscript in preparation for *International Journal of Academic Development*

Results were presented at ICED 2022 Conference, Aarhus (DK) on June 2nd 2022

Based on qualitative and quantitative research, the publication presents an overview of key factors that may affect the implementation of Challenge-Based Learning in ECIU University as a transnational alliance of 12 European higher education institutions. These include academic cultures, institutional regulations and structures, teaching and learning conditions, external stakeholders, colleagues support, teachers' attitudes and competencies as well as students' attitudes and competencies. Moreover, the paper describes interrelations and dynamics between some of the aspects that support and/or hinder the implementation. For instance, even though implementing CBL still heavily relies on the teacher's individual intrinsic motivation and their personal time and energy investment, an unfavorable institutional/academic culture may lead to a decline of the teacher's enthusiasm, whereas working with colleagues is depicted as clearly supportive.

4 Bibliography

Ellinger, Dorothea (2022) Deliverable Report 3.3, O3 conducted teacher training month 36.

Acknowledgements


Co-funded by the
Erasmus+ Programme
of the European Union