HOW TO MAKE GOOD TEACHERS GREAT IN CHALLENGE-BASED LEARNING

Karl Eldebo, Cia Lundvall, Charlotte A. Norrman, Madeleine Larsson

Linköping University (LiU) Department of Management and Engineering

ABSTRACT

This paper aims to analyze what roles are needed in the team that organizes a challenge-based learning (CBL) course or event. We also aimed to share our experience and provide advice on working with CBL in entrepreneurship courses. To fulfil this aim, we have analyzed four courses in the Erasmus+ project ScaleUp4Sustainability where CBL is used, using theories on experience-based learning models in general and the literature on CBL in particular. Our main finding 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. Together, these three roles can be labelled "teamcher". According to our own experience working with CBL, the teamcher role is preferably shared by a multi-disciplinary team of educators. CBL is resource-demanding education; hence, cooperation with actors such as tech transfer offices, innovation facilities and the regional innovation system can benefit this work. This is especially true as CBL has the ambition to contribute to society, something which also underlines the importance of regional triple helix collaboration.

KEYWORDS

challenge-based learning, experiential learning, enhancement of teaching methods, challenge-based innovation, entrepreneurship education, sustainability

Standards: 1, 2, 7, 8, 9, 10

INTRODUCTION

Challenge-driven innovation is high up on the agenda of initiatives such as HEInnovate and Horizon 2020 (European Commission, 2015). Challenge-based Learning (CBL) – also called Challenge-Driven Education (CDE) – is a relatively new way of working with entrepreneurial learning and entrepreneurship courses. Working with wicked, external and societal challenges that need innovation is a great way to set the stage and add relevance for students also in CDIO-based courses.

Today, more than a thousand higher education institutions within the EU educate tens of thousands of engineering students in the theory and skill of entrepreneurship (HEInnovate, 2021). The EU has distinguished entrepreneurship competences as one of the eight key competences for lifelong learning (Bacigalupo et al., 2016), defining entrepreneurial education to cover all activities "that seek to prepare people to be responsible, enterprising individuals who have the skills, knowledge and attitudes needed to prepare them to achieve the goals they set for themselves to live a fulfilled life" (Erkkilä, K. 2000, p 229).

Searching through the literature on CBL and related learning approaches shows much evidence regarding how CBL benefits students in higher education (Kohn Rådberg et al., 2020). However, less is written on didactical issues and on what is required by teachers that are, or want to be, engaged in CBL activities.

This paper aims to analyze what roles are needed in the team that organizes a CBL course or event, share our experiences, and provide advice on working with CBL in entrepreneurship courses.

The paper is outlined as follows: First, we build a frame of reference from the relevant literature on CBL to underpin our analysis. Next, we give a brief description of the methods used in the paper, followed by our data and our analysis. Finally, we give our conclusions and advice to those who want to engage in CBL.

CBL ACCORDING TO THE LITERATURE

CBL is a pedagogical approach with roots in the evolution of experience-based learning practices, which originated from the work of John Dewey (1938;1963) and later was further developed in pedagogical approaches such as problem-based learning (PBL), action learning, adventure education, simulation, and gaming (Kolb & Kolb, 2017). The tradition of PBL has deep roots in medical education programs, whereas project-based learning, which probably also could be seen as one in the above-mentioned family, has deep roots in engineering education (Biggs & Tang, 2011). CBL has been described by authors such as Malmqvist et al. (2015) as an evolution of PBL, although with the difference that CBL is more open and has a value-driven and entrepreneurial approach to solving societal concerns.

CBL is both applied and defined in various ways, and there seems to be no single and accepted definition or exact way of how it should be defined and run (Gallagher & Savage, 2020). According to Apple (2008), which was relatively early out in CBL, it can be described as an engaging and multidisciplinary TD learning approach, where students work collaboratively and solve authentic problems. Perez-Sanches et al. (2020) describe CBL as a pedagogical approach that "actively involves students in real-life, meaningful and context-related situations" (p. 6). According to a literature review by Gallagher and Savage (2020), CBL is characterized by (1) global themes, (2) real-world challenges, (3) collaboration, (4) technology, (5) flexibility, (6) multi-disciplinarity and discipline specificity, (7) creativity and innovation and (8) challenge definition.

In recent years, CBL has found its way into our education system, not least due to the formation of the ECIU – the European Consortium of Innovative Universities[1] – in 1997, of

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[1] https://www.eciu.org

which Linköping University is a part (Gunnarsson & Swartz, 2021). In the few years, challenge-based innovation and CBL have been advocated as the main approach within the ECIU. On its website, the following citation can be found: *"The core of the ECIU University is the challenge-based approach – a model where learners, teachers and researchers cooperate with business and society to solve real-life challenges."*[2]

Norrman et al. (2022) define CBL as an experiential learning approach that starts with wicked, open and sustainability-related real-life challenges that students, in cross-disciplinary teams, take on in their own way and develop into innovative and creative solutions presented in open forums.

CBL has also been related to the CDIO framework, which has been used at Linköping University since 2006 (Ouctherlony, 2006), and there are several similarities between these approaches. As an example, the paper by Gunnarsson and Swartz (2021) could be mentioned. In this work, the CDIO framework is used as a template when the authors develop and suggest a framework for education among the ECIU universities. Also, Kohn-Rådberg et al. (2020) compares the frameworks and finds them compatible.

Regarding the benefits of experiential learning approaches such as CBL, the literature is extensive in describing them – especially regarding those for students – and factors such as networking, real-life practice and skills related to technical, managerial, and organisational aspects are emphasized (Gallagher & Savage, 2020). Apple (2008) lifts forward that CBL enables 21st-century skills and creates active learning and motivation in the classroom. Lackéus (2020) finds that value-creation pedagogy (which is close to CBL) showed the highest development of both entrepreneurial skills and development of curricular knowledge and skills. In addition, the students' motivation was high, probably because of the connection to the real-world problems they solved.

Within the education system, a great palette of teaching methods facilitating student-centered learning like CBL and CDIO is present. Examples include active learning, action learning and self-directed learning. According to O'Neill and McMahon (2005), the term "student-centered learning" can be interpreted in many ways. However, one uncommon aspect is "that knowledge is constructed by students and that the lecturer is a facilitator of learning rather than a presenter of information" (O'Neill & McMahon, 2005, p. 28). Irrespective of how student-centered learning is applied, it entails requirements for a change in the teacher's role towards facilitation of the process to gain knowledge and skills rather than being a source of theoretical knowledge.

The didactic competence of the teacher regarding how education is planned and organized is important for the student's learning process. According to Børte et al. (2020), there has been a change in what is included in the teaching practice in higher education, and mainly toward a more student-centred approach. However, the same authors stress that the pedagogy (i.e., how teaching is conducted) is still stable, although new technology is utilised. This is despite it being shown (cf. Leong et al., 2016) that the pedagogic competence of the teacher influences the learning among the students.

The purpose of the course and its learning goals are of great importance in working with the students to support their ability to reach these goals. Lelong et al. (2016) advocate that even

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if the technical knowledge and skills as such are important, other skills are essential, and so also the issues of motivation to learn, develop and innovate. In CDIO, one of the mantras is that engineers must be able to engineer (Crawley et al., 2007), and hence education needs to foster both knowledge and skills, which also were the idea of the early thinkers (see Dewey 1963;1938). This is also supported in later works such as Kans (2016), Rotherham & Willingham (2010) and Olivares et al. (2019), who put forward the so-called 21st-century skills, which include analytical-, communicational, and teamwork abilities. According to the above studies, these skills can be obtained through pedagogical approaches such as CBL.

CHALLENGES IN TEACHING EXPERIENTIAL PEDAGOGICS

Olivares et al. (2019) claim that although the benefits of CBL are recognized, few educators have turned real-life challenges into practice in their teaching, probably because this type of pedagogy is "expensive" both with regard to effort and competence of the teachers. In this section, therefore, we will investigate the area of teacher skills and new pedagogies for CBL in general but also in the context of CDIO.

In the literature we can find two different challenges for teachers in CBL:

First, as the projects are based on problems from *stakeholders outside of academia*, students become very dependent on these stakeholders for information and feedback (Norrman & Hjelm, 2017). The teacher might have to take on a nontraditional role to help the student groups in this work (Hero & Lindfors, 2019). Not all external challenge providers engage the way they were expected, and the recruitment and retainment of external stakeholders are time-consuming (Norrman & Hjelm, 2017).

Secondly, teamwork and team members also become a major factor in the success of the work, which might both be a strength and a weakness in the progression of the course (Hauer & Daniels, 2008; Hero & Lindfors, 2019).

As CBL and CDIO are closely connected, as we have discussed earlier, we look to the literature concerning CDIO for discussions on the role of teachers:

Flarup and Wivel (2018), who have investigated mechanical engineering students engaging in CDIO courses in Aarhus, find that the teacher moved from giving answers to giving questions and from directing to supporting. They distinguish three different roles taken by teachers: (1) traditional teaching, (2) supervising the proceeding teamwork and (3) tutorial supervising – i.e., supporting students in, for example, exercises and the use of tools.

Hauer and Daniels (2008) describe the works with open-ended group projects (OEGP) in computer science education, pointing out that teachers are acting more as facilitators or consultants – supporting the students in making sense of the ill-structured problems they endeavor into in the course. "The general idea is that currently well-structured problems, at some point, probably started out as ill-structured problems, and this is part of the OEGP process: provide an ill-structured problem, with balanced scaffolding so students learn how to resolve such problems" (Hauer & Daniels, 2008, p. 90).

According to Kolb and Kolb (2017), the educator should take on as many as *four* roles during the process of experiential learning: the "Coach," who helps in initiating and starting the

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project; the "Facilitator," who encourages experiencing, imagining and reflecting; and the "Subject Expert" who supports in analyzing but also concrete thinking about the project together with the "Evaluator," who supports in deciding and acting upon what is learned.

The supporting role of the coach has also been highlighted by Klofsten and Öberg (2012), who describe a coach as someone with a strong connection to the program content who guides the team to develop a platform and a structured way of working forward in an entrepreneurial project.

We compare these authors and the teacher roles in CDIO they are describing in Table 1. Regarding Voogt et al. (2016), we distinguish between coaching/supporting students in their work and taking on the role of subject expertise, calling it "expert in practice".

Table 1. Comparison of teacher roles in CDIO

	Traditional teaching	Coaching/support the students	Expert in practice
Flarup and Wivel (2018)	Traditional teaching	Supervising the proceeding teamwork & Tutorial supervising	
Hauer and Daniels (2008)		Facilitator	Consultant
Kolb and Kolb (2017)	The Evaluator	The Coach (for teamwork) and the Facilitator (for practical use of methods)	The Subject Expert
Klofsten and Öberg (2012)		The Coach	The Mentor

To understand this multi-faceted role of the teacher, we must understand that the student, while being adult and mature, lacks the experience of context to be truly reflective about her/his actions and skills (Norrman & Hjelm, 2017; Hägg & Kurczewska, 2016). This means that when the student enters a setting well prepared for theory, practicing the theory will be problematic. This relates both to teamwork and aspects of the field that are practiced (Hägg & Kurczewska, 2016; Klofsten & Öberg, 2012).

All this complicates the role of the teacher and the situation of students even more, something we will look deeper into in the empirical findings.

METHOD

We have worked with CBL on two projects: an internal pedagogical project financed by Linköping University and the EU ERASMUS+ project ScaleUp4Sustainability (hereafter mentioned as "the S4S project;" see Acknowledgement for further details). In this work, we recognized that the areas where most efforts were needed were in the role of teachers and how to work with challenge providers. To deal with this, we decided to write two papers. Hence, this paper share parts of its frame of reference and data with Norrman et al. (2022).

This paper is based on four main sources of information. Firstly, we have reviewed the literature on experiential learning in general and CBL in particular. We have also regarded different frameworks for learning, such as CDIO. Secondly, we have used data collected from student and teacher reflections and from questionnaires that have been sent out to courses investigated in the S4S project. Additionally, we have held an interview with a CBL teacher active within the ECIU community, focusing on the teacher role (for more background on the ECIU, see Norrman et al., 2022). Finally, we used our own experience of arranging and running CBL courses and activities for several years. This research approach is by Lewin (1946) described as "action research" and by Hayano (1979) as "autoethnographic." If we go back to the roots, Dewey (1938), who advocated experience as the "means and goal of education," utilising our own practice and reflecting on it to move forward is, in practice, what CBL is about.

Background and Data collection within the S4S project (Courses A to D)

The partnership within the S4S project consists of two universities, one academic institute and seven companies. The project aims to develop new teaching modules in close collaboration with leading enterprises, using the ability of students to develop and assess new business solutions for a more sustainable world (Fichter et al., 2020). All courses in the project are challenge-driven, either by an external challenge provided or by aiming at one of the Sustainable Development Goals (SDG) or similar known societal challenges.

The S4S project started in 2018 as a result of a gap analysis made by Fichter et al. (2016). This analysis pointed out the need to further build on good examples and develop new courses for sustainable entrepreneurship and eco-innovation. In university courses, the aim for educators, using students as change agents for companies, is to develop students' skills and knowledge and, at the same time, make innovative, viable solutions for challenge providers. The four main courses included in the S4S project are described in Table 2 below.

The data from courses A to C were collected by an extensive evaluation, including interviews with students and teaching personnel and a quantitative survey. More detail about the interviews and surveys can be found in the report for Work Package 2, "Evaluating leading approaches and tools in collaborative green venturing," of the S4S project by Fichter et al. (2020). Course D was included in the S4S project but not part of the evaluation performed in Work Package 2. The data we present for course D was instead collected from the written student reflections submitted at the end of each run of the course. In total, 120 reflections were analyzed from 13 course runs in the period 2014-2020, and the main points are highlighted in this paper.

Table 2. The four main courses included in the S4S project and from which experiences are presented in this paper.

Course A:	Eco-Venturing at the University of Oldenburg
Start year:	2009 (ongoing)
Duration:	24 weeks (one semester)
ECTS:	6
Description:	The main target of the course is to develop entrepreneurial skills for the development and implementation of environmental innovations and sustainable business ideas.
Course B:	Environmentally Driven Business Development at Linköping University
Start year:	2013 (ongoing)
Duration:	20 weeks (one semester)
ECTS:	6
Description:	The course aim is to develop the capabilities to formulate and plan a desirable, viable and feasible business solution for an environmental problem.
Course C:	Fujifilm Future Challenge at Avans University of Applied Sciences
Start year:	2016 (ongoing)
Duration:	10 weeks
ECTS:	2
Description:	The students are to generate new sustainable businesses for the external challenge provider (in this case, Fujifilm). In this, they learn theory and practice in both ideation and validation of business cases.
Course D:	InGenious Cross disciplinary project
Start year:	2014 (ongoing)
Duration:	20 weeks (one semester)
ECTS:	8
Description:	This cross-disciplinary course is open for all students through ECIU having 90 or more ECTS in whichever discipline. It is a collaboration between Linköping University, Region Östergötland and the region's two largest municipalities, Linköping and Norrköping, aiming to build bridges between the region and the students at the university. Through this partnership challenge providers are found, supplying the challenges students take on in the course.

DATA

Student experiences from CBL (data from courses A, B, C and D)

Positive experiences

Students in all three courses lifted the challenge-based learning and real-life experiences as something very positive. In courses A, C and D, the opinions were very positive regarding the challenge provider and the support that students received from the external parties – a "taste of real work," as one student said. In course B, students have the option to come up with their own solutions, often based on broader societal challenges. This freedom is by some students considered as good, for some, a bit unclear. The personal development attained in the courses is lifted by several students, both in group work aspects as well as skills in pitching and contacting customers.

Students lifted that the teachers did not only work in a traditional way. The teachers were perceived "more as coaches or mentors," working together with the students and people from external parties. Students reacted very positively to this change in the teacher's role in supporting, brainstorming and guiding. In all four courses, the teachers' commitment was lifted as something positive.

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According to the students, the main learning outcomes were hands-on, practical experience in entrepreneurship and teamwork, as well as new insights into sustainability challenges. As an example, self-evaluations taken before and after course B show that students significantly change their knowledge in both the practical and strategic field of sustainability during the course. Learning from peers is also lifted, as students are required to work with students from different programs and specializations.

Subjects for improvement

The open-end group project setting for all courses was seen as something inherently positive by the students but also challenging and demanding. In all courses, students lifted the need for more coaching – either by teachers or external parties. The need for coaching was related to three different areas:

1) Assistance in practical questions: Students requested more support in time management of the project and selection and using the theoretical tools, and sometimes needed help when encountering setbacks in the development of the innovative solution.

2) Assistance in team-related questions: Some student groups found the team constellation challenging. Group contracts and constant teamwork development take time, and some teams needed more time with teachers to help get the group together.

3) Expectation management: Especially in courses A and B, where the challenge providers were not as clear as in courses C and D, some students requested more help in setting the right level for the group work. The evaluations showed that students felt all three courses took more work per credit than other university courses.

Teacher experiences from CBL (data from courses A, B, C, D and the ECIU)

Positive experiences

All teachers involved in all three courses see the setup with challenge-based learning as something positive. They all express the impressive solutions that students arrive at within the limited time given.

All courses have more than one teacher involved. In courses B, C and D, the roles of the teachers are also pre-defined: one as a teacher and one as a coach. But all teachers also express the feeling that they take on a non-traditional role of coaching the students rather than teaching them. This is seen as something both positive and challenging at the same time.

Teachers in courses with external challenge providers (A, C and D) are very content with the engaged external parties.

Subjects for improvement

Time is the major limitation of all courses. According to the teachers, managing the external challenge providers, the normal course administration and the students' group work takes time and creates a sense of "split vision." Even in courses with set roles (teacher and coach), time is the greatest delimitator.

Some student groups work without needing much support, but in some groups, teachers must help quite a lot to ensure progress regarding both teamwork and the actual development of

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the project. This makes time management hard. There are suggestions that skills in team building should be added to the learning goals and assessed – thus lifting its importance.

Communication between all parties (teachers, students and external parties) is also lifted as a challenge during the course. The challenge providers can open many doors for students, giving them access to interviewees and information needed, but they also have their own time management to think of, and the teacher then often becomes the fallback for students who are unable to reach their challenge providers when needed.

Finding and onboarding external challenge providers is also a time-consuming task. Most external parties are engaged through the personal network of the teachers and coaches involved. Here, support from universities' technology transfer offices is mentioned as a desire for managing and finding challenge providers.

ANALYSIS AND DISCUSSION

According to our empirical findings and with support from the literature, there are three main overarching themes that we would like to highlight in the analysis:

Theme 1: Freedom vs. ambiguity

CBL, like all entrepreneurial learning initiatives, really stresses the "free," innovative approach to a challenge (or problem). This way of learning is, according to our data, highly rated among the students as well as teachers. This is connected to what we have found to be one of the most important strengths of CBL: It simulates real work-life situations for students in a way that more traditional teaching never does. This corresponds well to the analysis of CBL made by Gallagher and Savage (2020), the findings of Perez-Sanches et al. (2020) and the assessment of Lackéus (2020).

This freedom also comes with a high dose of ambiguity. Students might find the way forward unclear, the criteria for grading vauge, 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. Keep in mind that contact with challenge providers will take time and could be demanding as it requires a contact network that not all university teachers have. A complicating factor is that the challenge providers have their day job schedules to heed and hence cannot always pay full attention. Teachers often work hard with *transparency*: both in the case of clear descriptions of the process and what will happen in each step and the case of criteria for judgement and grading. Still, the ambiguity in the context created through the challenge can be demanding for students. Although this is mentioned by some authors (cf. Malmqvist et al., 2015; Norrman & Hjelm, 2017), this ambiguity is rarely elaborated on in the literature. However, it is mentioned that students must be mature and take great responsibility (cf. Hägg & Kurczewska, 2020; O'Neil & McMahon, 2005).

Theme 2: Teamwork

In CBL, as well as other OEGP disciplines, the student team is a major factor for success. Students express many favorable aspects of the need for teamwork, both as a source of

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personal development and preparation for work-life and learning from other students with different skills and backgrounds.

Both students and teachers highlight the downside of teamwork: If the team does not work well together, the advancement of the whole project can be threatened. Therefore, CBL teachers often put a great deal of work into forming groups of students and coaching them regarding teamwork progress during the courses. Most students have been working in teams before, but our analysis as teachers shows that CBL pedagogics puts a higher demand on teams being fully functional than other courses do.

The relevance of functioning teamwork between students is presented in the literature on several occasions, as well as the downside of non-functioning teams (cf. Hauer & Daniels, 2008; Kolb & Kolb, 2017).

Teamwork among teachers is something that is seldom elaborated on, but when it comes to CBL, it 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.

Theme 3: Time management

This third theme is strongly connected to the other two. Working with free and ambiguous projects in teams takes time. In our student evaluations, most students note that they work more hours per credit than they usually do. And still, they also wish for *more time for external contacts and teacher support*.

Teachers also find the courses demanding, as they plan for teaching, coaching and supporting. Keeping student teams aligned, communicating with external parties, and dealing with expectations management on all frontiers is taxing, and the work is also hard to foresee and plan.

There are some cases raised in the literature on this topic, for example, the time needed for external participation (Norrman & Hjelm, 2017), the time limitations in open-ended group work projects (Hauer & Daniels, 2008) and the teacher being split between tasks (Klofsten & Öberg, 2012).

The Role of the Teacher

From the literature on CDIO, we found three different roles that were defined by several authors (see Table 1):

- The Traditional Teacher – The academic teacher role, which includes course creation and development of formal course plans, including formulation of learning goals and clear assessment criteria. This role also includes being the examiner of the course. This role is mainly oriented towards enabling the students to acquire knowledge.
- The Coach, supporting the students – Facilitating and coaching students in their development project, support in group dynamics and support to overcome problems along the way. This role is mainly oriented toward enabling students to acquire skills.

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- The Expert in Practice – Guiding students in their studies of the challenge and supporting them in finding empirical evidence, interviewees and data to test and validate their solutions to the challenge. This role is fully oriented to practice and work-related knowledge.

Comparing these roles to our empirical findings, we see that the teacher with the academic responsibility is needed for studies in higher education and CBL, which is very important in helping students tackle ambiguity. Teachers supply clear learning goals, a well-formulated curriculum and the theoretical frameworks for analysis that are applied within the CBL process.

The Coach is an equally important role, as it encompasses supporting students in both the important teamwork and the sometimes waxing degrees of freedom that they experience. The coach also handles group dynamics issues and encourages the students through asking questions that move their innovation process forward.

The role of the Expert in Practice is not as present in CBL as it is in CDIO. However, in CBL, the Expert in Practice is equal to the external challenge provider. This is because the teachers and coaches are not the subject experts on the external challenges. The challenge provider supplies the students with context and information on their challenge and works as a sounding board in their development work.

Finally, putting the pieces together calls for a fourth role, which must be included in the teacher team: the Organizer. The Organizer role is about finding challenge providers, creating challenge briefs that suit the purpose of the CBL course and benefit the challenge provider and handling immaterial property rights issues and contracts (if used) between challenge providers and students.

Our suggestions for teacher roles in CBL

As we have put the context expert role on the challenge provider, three roles remain for the teacher in CBL. Through our analysis, where we have compared the literature with our empirical findings and experience, we have distinguished three main roles needed in the teacher team of a CBL course:

1. **The Academic Teacher**
   Enabling the students to acquire knowledge.
   Includes course creation and development of formal course plans, including
   formulation of learning goals and clear assessment criteria as well as examination.
2. **The Coach**
   Enabling students to acquire skills.
   Includes matching students to projects, coaching of the students in their development
   project, support in group dynamics and support to overcome problems along the way.
3. **The Organizer**
   Facilitating interaction and work with external parties.
   Includes finding challenge providers, the creation of challenge briefs, the handling
   immaterial property rights issues and contracts.

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Toward a definition of TEAMCHER

In CBL, the learning goals are oriented toward both knowledge and skills – that is, it combines theory and practice. Hence CBL incorporates more than traditional courses and consequently requires more than what is included in the traditional teacher role.

To find a proper denomination, "teamcher" has become a rather commonly used etiquette to describe the different requirements of leaders in CBL. Teamcher is mentioned in papers such as Gunnarsson & Swartz (2021) and within the ECIU-sphere; however, no explicit and clear definition of the concept is given.

Based on this research, we therefore suggest that the teamcher role includes both enabling knowledge and skills and the ability to set the scene for this. Hence, we define a teamcher as an individual who, either on their own or as a part of a team, arranges, leads and supports CBL activities. Teamchers take, and often also slide between, the roles of being teacher, coach and organizer of CBL activities.
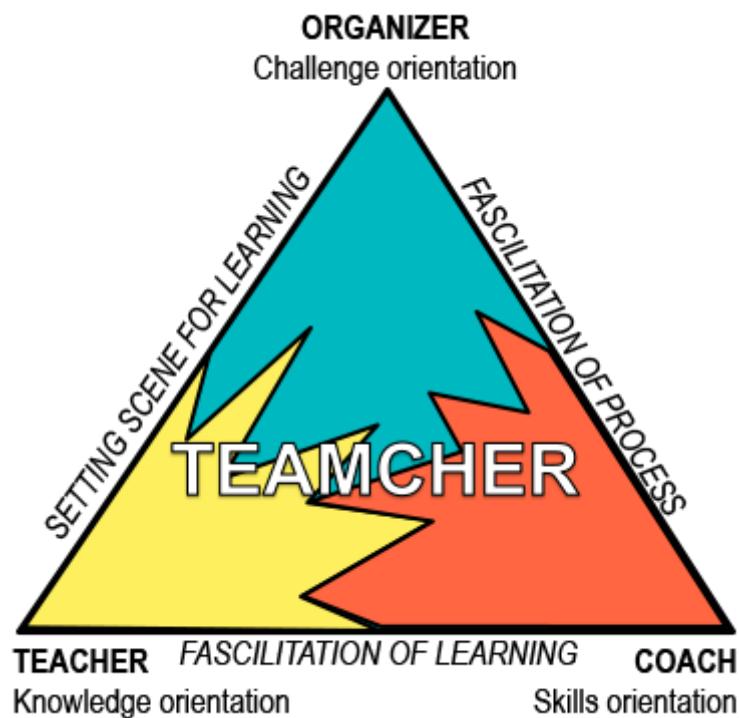

Figure 1: The Teamcher, own design

CONCLUSIONS

This paper aimed to analyze what roles are needed in the team that organizes a CBL course or event and to share our experiences and provide advice on working with CBL in entrepreneurship courses.

We have reached the following conclusions:

- For challenge-based learning to work, three main roles are required: the academic teacher, the coach and the organizer.

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- If taken together, these three roles could be labeled as "teamcher," which we define as an individual that, either on their own or as a part of a team, arranges, leads and supports CBL activities.
- From a teamcher perspective, CBL can be seen as both demanding, especially regarding resources, and rewarding. Hence, our recommendation is to start small and add on until a full CBL setup is reached.

In the paper, we have reflected upon our own practice and shared our experience regarding teaching and organizing CBL courses.

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REFERENCES

Apple (2008) Challenge-based learning – Take action and make difference. https://www.apple.com/ca/education/docs/Apple-ChallengedBasedLearning.pdf

Bacigalupo M, Kampylis P, Punie Y and Van Den Brande L. (2016) EntreComp: The Entrepreneurship Competence Framework. EUR 27939 EN. Luxembourg (Luxembourg): *Publications Office of the European Union*. JRC101581

Biggs, J., & Tang, C. (2011). Teaching for quality learning at university. *McGraw-hill education* (UK).

Børte, K., Nesje, K., & Lillejord, S. (2020). Barriers to student active learning in higher education. *Teaching in Higher Education*, 1-19.

Crawley, E., Malmqvist, J., Ostlund, S., Brodeur, D., & Edstrom, K. (2007). Rethinking engineering education. *The CDIO Approach*, *302*, 60-62.

Dewey, J. (1938; 1963). Experience and education, The Kappa, Delta, Pi Lecture Series, *Macmillan Publishing company: New York*

European Commission (2015) Entrepreneurship Education: A road to success. Ref. Ares (2015)338751 - 28/01/2015

Erkkilä, K. (2000). Entrepreneurial education: mapping the debates in the United States, the United Kingdom and Finland. *Taylor & Francis*.

Flarup, J., & Wivel, H. (2018). Training The Staff – How to Develop Personal and Interpersonal Competencies at Faculty Level. *Proceedings of the 14th International CDIO Conference*, Kanazawa Institute of Technology, Kanazawa, Japan, 12.

Proceedings of the 18th International CDIO Conference, hosted by Reykjavik University, Reykjavik Iceland, June 13-15, 2022.

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Fichter, K., Fuad-Luke, A., Hjelm, O., Klofsten, M., Backmann, M., Bergset, L., Bienkowska, D., Clausen, J., Geier, J., Hirscher, A. L., Kanda, W., & Kuisma, M. (2016). SHIFTing the Support of Entrepreneur- ship in Eco-Innovation. *Summary of results and recommendations from the Eco-Innovera project SHIFT*. SHIFT Consortium.

Fichter, K., Hurrelmann, K., Seela, A., Hjelm, O., Larsson, M., Sundberg, C., Wisdom, K. & Stel, F. (2020). S4S Report on evaluating leading approaches and tools in collaborative green venturing (Work Package 2). Oldenburg, Linköping and Zuidlaren

Gallagher, S. E., & Savage, T. (2020). Challenge-based learning in higher education: an exploratory literature review. *Teaching in Higher Education*, 1-23.

Gunnarsson, S. & Swartz, M. "Applying the CDIO Framework When Developing the ECIU University" *Proceedings of the 17th International CDIO Conference*, *hosted online by Chulalongkorn University & Rajamangala University of Technology Thanyaburi*, Bangkok, Thailand, June 21-23, 2021.

Hauer, A., & Daniels, M. (2008). A Learning Theory Perspective on Running Open Ended Group Projects (OEGPs). Proc. Tenth Australasian Computing Education Conference (ACE2008), Wollongong, Australia, 78, 8.

Hayano, D. M. 1979. Auto-ethnography: Paradigms, problems, and prospects. *Human Organization*, 38, 113-120.

HEInnovate (2021, 01, 10) An initiative of the European Commission's DG Education and Culture in partnership with the OECD. https://heinnovate.eu

Hero, L.-M., & Lindfors, E. (2019). Students' learning experience in a multidisciplinary innovation project. Education + Training, 61(4), 500–522. https://doi.org/10.1108/ET-06-2018-0138

Hägg, G., & Kurczewska, A. (2016). Connecting the dots – A discussion on key concepts in contemporary entrepreneurship education. Education + Training, 58(7/8).

Hägg, G., & Kurczewska, A. (2020). Guiding the student entrepreneur – Considering the emergent adult within the pedagogy–andragogy continuum in entrepreneurship education. Education + Training, 62(7/8), 759–777.

Kans, M. (2016). What Should We Teach?: A Study of Stakeholders' Preceptions on Curriculum Content. In *12th International CDIO Conference, Enhancing Innovation Competencies through advances in engineering education, Turku, Finland, June 12-16, 2016* (pp. 266-278). Turku University of Applied Sciences.

Klofsten, M., & Öberg, S. (2012). Coaching versus mentoring: Are there any differences? In New technology-based firms in the new millennium. *Emerald Group Publishing Limited*.

Kolb, A. Y., & Kolb, D. A. (2017). Experiential learning theory as a guide for experiential educators in higher education. *Experiential Learning & Teaching in Higher Education*, *1*(1), 7-44.

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.

Lackéus, M. (2020). Comparing the impact of three different experiential approaches to entrepreneurship in education. *International Journal of Entrepreneurial Behavior & Research*, 26(5), 937–971.

Leong, H., Singh, M. N., & Sale, D. (2016). Enhancing teaching skills: a professional development framework for lecturers. In *The 12th International CDIO Conference* (p. 760)

Proceedings of the 18th International CDIO Conference, hosted by Reykjavik University, Reykjavik Iceland, June 13-15, 2022.

806

Lewin, K. 1946. Action Research and Minority Problems. Journal of Social Issues 2: 34-46.

Malmqvist, J., Rådberg, K., Lundqvist, U. (2015). From problem-based to challenge-based learning – motives, examples, outcomes and success factors. *2015 11th International CDIO Conference*, Chengdu, China

Norrman, C., Lundvall, C., Eldebo, K., Boiertz, S., and Stel, F., (2022) Making Good Challenges Great – Engaging External Parties in Cbl-activities, *18th CDIO Conference* June 13-15 2022, Reykjavik, Iceland.

Norrman, C., & Hjelm, O. (2017). CDIO-based entrepreneurship courses as drivers of innovation in industrial segments. In *13th International CDIO Conference*, University of Calgary, Calgary, Canada, June 18-22, 2017 (pp. 288-297). University of Calgary.

Olivares, S. L., Adame, E., Treviño, J. I., López, M. V., & Turrubiates, M. L. (2019). Action learning: challenges that impact employability skills. *Higher Education, Skills and Work-Based Learning*.

O'Neill, G., & McMahon, T. (2005). Student-centered learning: What does it mean for students and lecturers.

Ouchterlony, U., A Project For The Programme of Information Technology at Linköping University, 2006, 2nd International CDIO conference, Linköping university, Sweden.

Pérez-Sánchez, E. O., Chavarro-Miranda, F., & Riano-Cruz, J. D. (2020). Challenge-based learning: A 'entrepreneurship-oriented' teaching experience. *Management in Education*, 0892020620969868.

Rotherham, A. J., & Willingham, D. T. (2010). 21st-century" skills. *American Educator*, *17*(1), 17-20.

Voogt, M., Chuan Sheng Chen, & Thota, N. (2016). Academics' experience of teaching Open Ended Group Projects: A phenomenographic study. 2016 *IEEE Frontiers in Education Conference* (FIE), 1–7.

Proceedings of the 18th International CDIO Conference, hosted by Reykjavik University, Reykjavik Iceland, June 13-15, 2022.

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BIOGRAPHICAL INFORMATION

Karl Eldebo is a Lecturer and PhD student at the Division of Environmental Technology and Management at the Department of Management and Engineering at Linköping University. He has taught entrepreneurship and innovation management for five years to engineering students. His research is mainly focused on the dissemination of innovation for a sustainable world.

Cia Lundvall is a facilitator at Almi East Sweden AB and part-time lecturer at the Department of Management and Engineering at Linköping University. She has previously worked with marketing and taught students in rhetoric and Swedish at Upper Secondary Schools for many years. As a facilitator, she monitors the students' group process, sees that the projects progress and trains the students in pitch technique.

Madeleine Larsson is an Assistant Professor at the Department of Management and Engineering at Linköping University (LiU). Her research is mainly connected to environmental technology, sustainable energy and nutrient supply and collaboration between students and companies for sustainable solutions. The last three years she has been teaching/supporting engineering students in a project course where the students work with sustainability related projects at companies.

Charlotte Norrman: is an Associate Professor at the Department of Management and Engineering at Linköping University (LiU). Her research focus is innovation and entrepreneurship in early stages ventures, and she also work with regional development. Her teaching is in the area of innovation and entrepreneurship. She has contributed to the CDIO-conference several times and is also engaged within the ECIU community.

Corresponding author

Karl Eldebo
Linköping university
Dept. of management and engineering
Linköpings universitet 58183 Linköping
karl.eldebo@liu.se