Chapter 16

Challenge Based Learning: Recommendations for the Future of Higher Education

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Abstract

This chapter provides a critical discussion of challenge-based learning (CBL) within future trends in higher education (HE). It explores how CBL may address challenges facing higher education institutions (HEIs) in response to these future trends by using a framework of common CBL characteristics. Clear recommendations for CBL practitioners to succeed in CBL implementation within the ever-changing HE landscape are presented. It complements previous chapters on CBL case studies by situating CBL in the broader HE space. A discussion on the interrelationships between these characteristics and predictions on the future integration of CBL in HE concludes this chapter. These macrolevel discussions of CBL will be of interest to government officials, managers, business stakeholders, teachers, policy advisors, and academic teachers. Insights on the future institutional impact of CBL, how it may improve business and academic collaborations, how it aligns with sustainability and transversal skills policies, and where CBL is situated in the post-COVID-19 landscape are discussed. Ultimately, it argues that CBL is part of a pedagogical toolkit to meet future trends in HE.

Keywords: Future trends; higher education; educational transformation; pedagogy; challenge-based learning; sustainability education

Introduction

Higher education (HE) has seen many transformations throughout history. Changes in social and cultural norms, national and international policies, institutional organizational structures, pedagogical theories, and philosophical

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ideologies have all influenced higher education institutions (HEIs) we teach and learn in today. These transformations are not solely rooted in the past, and HE continues to renew and reinvent itself over time. Knowledge of future trends in HE is increasingly relevant for educational researchers, academic teachers, policymakers, and university strategists to gain broader perspectives, detect future threats and opportunities, and innovate teaching and learning practices. It is particularly important for nascent pedagogies such as challenge-based learning (CBL). Methods for identifying these trends are as varied and wide ranging as the interests and backgrounds of authors. For example, industry associations surveying stakeholders (Pelletier et al., 2021; Quacquarelli Symonds, 2020), supranational policy data analyses (Chircop, Karakas, Kiss, Szczepanski, & Schomaker, 2020), expert academic collaborations (Kukulska-Hulme et al., 2021), reflective opinion pieces (Kim & Maloney, 2021), discussions emerging from peer-reviewed research (Rossing, Miller, Cecil, & Stamper, 2012), and commentary in response to larger global trends (Grapragasem, Krishnan, & Mansor, 2014).

Recently, these future-focused publications have highlighted trends such as student demographic changes, globalization, emerging technologies, online education, future work and skills, collaboration between HEIs and industry, and sustainability as being key factors for HE transformation. When defining the key characteristics of CBL in previous research, the authors observed a strong connection between these relatively disparate trends and the design, implementation, and evaluation of CBL activities.

In this chapter, we will argue that CBL is a key part of the HE pedagogical toolkit to meet future trends in HE. We will explore and discuss in detail how future trends in HE and the characteristics of CBL are strongly interlinked. For example, *Global themes*, a key characteristic of CBL, commonly appears in policies encouraged in education, such as the Sustainable Development Goals (SDGs). *Real-world challenges* and *collaboration* are apparent in future trends toward greater collaboration between education and industry, the promotion of situated learning, new employment typologies, and the greater adoption of transversal skills within HE competencies.

The move from traditional disciplinary skills to *multidisciplinarity* is being encouraged by many supranational organizations (e.g., European Commission) to improve student employability and address complex skills and challenges faced by our world. CBL is firmly placed within this future trend through its use of multidisciplinary stakeholders and broad challenge-based outputs. The impact of COVID-19 on teaching and learning practices has placed *technology enhanced learning (TEL)*, another key characteristic of CBL, at the forefront of all HEIs. It remains to be seen how the HE landscape will respond to the move to Emergency Remote Teaching in the future, but its impact will undoubtedly be felt for years to come. Other key features of CBL such as *innovation* and *flexibility* will also be discussed in terms of how their use in CBL may align with future trends in HE, such as student demographic changes and the greater importance on instructional design. This chapter concludes with a discussion on the interrelationships between these characteristics, provides predictions on the future integration of CBL in

HEIs, and describes recommendations for CBL practitioners to succeed in CBL implementation within the ever-changing HE landscape.

However, in order to fully explore and comprehend where the future of HE lies, and how CBL fits within future trends, we must look to the past.

Background

Much is made of the resilience of the university as an institution in society that has, on the surface at least, remained largely unchanged for over 800 years (van der Zwaan, 2017). This view, however, fails to recognize that transformation is a constant feature of HE through the ages. From the competing visions of Newman, and von Humboldt, to the challenges of globalization and the digital revolution (Willetts, 2017), HEIs are constantly responding and adapting to changing national, international, social, and economic contexts within which they function, while at the same time attempting to hold true to laudable mission and vision statements (Chircop et al., 2020). HE appears to be in a permanent state of transformation, or even crisis, with publications every decade foretelling calamity such as the 1900 work *Crisis on the Campus* to the more recent 1995 work *Higher Education in Crisis* (Mintz, 2017). What this demonstrates is that there are long-running tensions in HE alongside the more immediate challenges that HEIs are required to respond to in each age.

The Changing Purpose of Higher Education: Instrumental vs. Liberal

One of the longest running tensions across HE is its purpose. Societies have viewed the HE of significant portions of their young people as a prerequisite (*sine qua non*) for ongoing economic and social progress. While the economic and social benefits of HE are not mutually exclusive, there has long been a debate around the purpose of HE. The more instrumentalist view (Willetts, 2017) sees HE as what Collini described as "manpower planning, the training of future employees in a particular economy" and focuses on the economic benefits to both the individual and society (Collini, 2012). This perspective considers whether a subject or course of study is "useful" as usually defined by the extent to which it prepares a student for employment within a specific current or future profession. Hence a "useful" course or subject is one that most closely aligns with the economic justifications for the massive increase in HE.

Another perspective of the purpose of HE perceives the role of HE in the development of an individual's understanding of themselves and the world within which they live. This view, often referred to as liberal education, identifies benefits to both the individual and society from having an educated and enquiring population, the promotion of democratic citizenship, the development of a global perspective, and critical thinking among students. This broader purpose of HE still recognizes the value and importance of skills relevant and appropriate for economic or employability benefits; however, it takes a more holistic view of the benefits to the individuals concerned.

> It educates them in order that they should extend and deepen their understanding of themselves and the world, acquiring, in the course of this form of growing up, kinds of knowledge and skill which will be useful in their eventual employment, but which will no more be the sum of the education than that employment will be the sum of their lives.
>
> (Collini, 2012)

What is agreed, regardless of the perspective on education taken, is that the skills and competencies required in the near future are going to be fundamentally different from those currently being engendered in the current HE system. We argue that these new skills and competencies strongly align with a CBL approach to teaching and learning.

The Need for New Student Skills and Competencies

Within the European Union (EU), an increasing recognition of skills mismatch between the current skillset of its citizens and the region's current needs required for innovation and competitiveness is evident. Many skills highlighted are those required across two broad domains: digital skills and the so-called "green skills," reflecting the major transformative imperatives of the digital revolution and global sustainability.

The digital transformation of the economy and society, in general, requires digital skills, knowledge, and competencies required to support digital transformation (Chircop et al., 2020). Current estimates are that up to 90% of jobs soon will require some level of digital skills. This has been reinforced by the move to remote online working for many industries during the COVID-19 pandemic.

The EU has created a framework identifying what it considers to be the critical digital competences to support transformation, the European Digital Competence Framework for Citizens (DigComp) (European Commission, 2019). These include competences in information and data literacy, communication and collaboration, digital content creation, problem-solving, and safety. In the context of the tension between an instrumentalist view of HE and a more liberal one, the Digital Competence Framework references lifelong learning, inclusion, equality of opportunity, as well as access to the labor market among its rationale. This acquisition of digital skills and competences are vital components of a successful life in the future.

Digital competences are not the only impact of the digital revolution on education for the future as outlined in the EU's Digital Education Action Plan. In addition to the need to develop digital competencies, they promote digital technologies and practices to enhance the teaching and learning methods, as well as the use of AI and big data to analyze, investigate, and improve educational outcomes (Chircop et al., 2020). This is significant for CBL as one of its key characteristics is the use of TEL.

Another key skill is linked to the increasing need for societies to become more sustainable. This is reflected in the increasing focus on sustainability strategies (e.g., the SDGs), competencies for sustainability practice, and the demand for citizens to have "green skills" (Bianchi, 2020). Students are also seeing sustainability as a key competency necessary for completing their studies (Bordonau, Olivella, & Velo, 2017). While the distinction between competences and skills may appear arbitrary, in most contexts skills refer more specifically to the application of competences within specific employments. A feature of these types of green skills is their cross-cutting nature as they:

> combine crosscutting competences with 'specific' skill sets. The main types of 'green skills' are in the domains of engineering, technology, science, operations management (e.g. cooperation with regulators and customers) and monitoring (observance of technical criteria and compliance with environmental laws and standards).
>
> (Chircop et al., 2020)

Sustainability competences, or competencies for sustainable development as they are often known, are a way of describing educational outcomes. They include the knowledge, skills, and attitudes traditionally associated with skills based education and employability alongside the personal, cognitive, ethical, and functional dimensions (Lozano, Merrill, Sammalisto, Ceulemans, & Lozano, 2017). Lozano et al. (2017) reviewed a range of existing competence frameworks for sustainable development and created a synthesis of 12 competences aligned with a range of pedagogical approaches in a connected framework; systems thinking, interdisciplinary work, anticipatory thinking, justice responsibility and ethics, critical thinking and analysis, interpersonal relationships and collaboration, empathy and change of perspective, communication and use of media, strategic action, personal involvement, assessment and evaluation, and tolerance for ambiguity and uncertainty. CBL does not appear in their list of pedagogies; however, close cousins, project- and problem-based learning, do appear and have arguably the best "fit" to the entire range of sustainability competences.

Digital and sustainability competences are vitally important for the future of our society, our economy, and the planet itself. They align with both sides of the dualistic tension between instrumentalist and liberal educational models and combine both. However, these are not the only competencies identified as crucial; recognizing and analyzing problems, collaboration and cooperation, recognizing one's own role in the global community, interdisciplinary work, and innovation have all been identified as key future competencies (Rieckmann, 2012). In addition, unexpected and rapid changes to HE, such as emergency remote teaching during the COVID-19 pandemic, demonstrate how competencies can be driven into the background or be catapulted into greater importance when a Black Swan event occurs.

Within our contemporary society, following the COVID-19 pandemic in particular, we argue that CBL is a potentially valuable approach to allowing students to acquire these competences.

Identifying the Place of Challenge-Based Learning Within the Future of Higher Education

As we have seen, the future of HE is rapidly evolving, and there is a need for future-focused skills and competencies to be integrated within future trends, policies, curricula, and teaching and learning approaches. Exploring where CBL may apply and lie within these elements can determine how, why, and whether CBL has a future within HE. However, a major challenge to this is the definition of CBL. CBL has been defined, adapted, and used in many ways across diverse disciplines and educational settings. This wide array of different educational interventions and approaches has caused definitional and conceptual challenges for CBL; as such, a framework for integrating future HE trends with CBL characteristics is needed.

Previous research by Gallagher and Savage (2020) analyzed 100 HE CBL peer-reviewed literature via literature review and presented eight broad themes clarifying CBL characteristics across diverse disciplines and teaching case studies. Global themes, real-world challenges, innovation and creativity, multi-disciplinarity, collaboration, TEL, and flexibility were identified via a content analysis of said literature. This thematic framework of CBL characteristics (Gallagher & Savage, 2020) will be used to scaffold our discussion. Given the definitional complexity and "fuzziness" related to CBL, these themes will be used to explore the future of HE and teasing out how and where CBL may fit, or even lead, in future curriculum and pedagogical innovation (Fig. 16.1).

The following sections describe each CBL characteristic in terms of future trends in HE and provide recommendations for HEI educators, managers, and strategic planners for integrating CBL into policy, teaching, and curricula.

Global Themes

> the importance of education lies in helping people recognise their role and individual and collective responsibilities as active members of this global community in the sense of engagement for social and economic justice for all and the protection and restoration of the earth's ecosystems.
>
> (Global Education Guidelines Working Group, 2010)

The essence of CBL is learning by seeking solutions to big questions which align with global themes and worldwide interest (Fidalgo-Blanco, Sein-Echaluce, & García-Peñalvo, 2016). Published literature on CBL often describes how challenges were rooted in issues of global importance, such as global affordable

Fig. 16.1. Characteristics of Challenge-Based Learning.
Source: Gallagher and Savage (2020).

energy (Bordonau et al., 2017), preventing nuclear terror, engineering better medicines, and restoring and improving urban infrastructure (Malmqvist, Rådberg, & Lundqvist, 2015). These types of challenges are strongly linked to global, national, and institutional policies, often within the context of sustainability or the SDGs (Gibson, Irving, & Scott, 2018).

Addressing sustainability in education is not only relevant for the present, but has been identified as an area that will be embedded within future curricula and pedagogies (Common Worlds Research Collective, 2020) and global goals. SDG 4.7 "Education for Sustainable Development and Global Citizenship", for example, seeks to

> ensure that all learners acquire the knowledge and skills needed to promote sustainable development, including, among others, through education for sustainable development and sustainable lifestyles, human rights, gender equality, promotion of a culture of peace and nonviolence, global citizenship and appreciation of cultural diversity and of culture's contribution to sustainable development.

Targets such as these are increasingly embedded within national and institutional strategies, and HEIs play a key role in driving this achievement (Chankseliani & McCowan, 2021). This focus on sustainability demonstrates that challenges related to global themes are a requirement for institutional future strategic goals, and the wider desire for global sustainability.

Aside from the pedagogical structure of CBL being beneficial for addressing broad global themes, CBL can also be a driver for future trends toward teaching sustainability in HE. Given the importance of sustainability competencies for the future of our planet, CBL is well placed to scaffold these competencies within its activities.

Recommendations

- Frame challenges using existing global SDGs.
- Incorporate global broad themes into curricula.
- Integrate sustainability competences and green skills into the teaching and learning process.
- Align local or national level challenges with a broad global outlook to inform students on their wider importance.

Real-World Challenges

> Many students graduate without ever learning to be comfortable while dealing with problems that are complex and ill defined.
> (Lombardi & Oblinger, 2007 as cited in Foster & Yaoyuneyong, 2016)

The future of education is strongly linked with both current needs of employers and future needs of the economy and society. This is evident in the move to increasing student employability as a key mission for many HEIs (Suleman, 2018). For HEIs, preparing students for the job market requires real-world experiences to be taught within an academic context. For students, there is a need to have skills and competencies to address real-world challenges, relevant to employers. For employers, employees need real-world experience and skills, in addition to theoretical and more academic knowledge. These needs can be seen by students and employers calling for HEIs to better prepare graduates for the workplace. Within the context of CBL, students connect learning content with real-world challenges which help them to have a deeper understanding of the content (Nichols, Cator, & Torres, 2016).

For HEIs to stay ahead of fast changes in future skills (i.e., digital literacy) they need to partner with industries to be cognizant of these changes and adapt teaching methods to integrate these new methods. There are many benefits of active collaboration between academia and industry via student learning

opportunities, for all stakeholders. For example, the 2020 Eurograduate survey found increased prospects for students who had undertaken work experience. Business engagement promotes symbiotic relationships whereby graduates develop the competencies business requires, universities are funded by business for knowledge creation, startups are supported, and research outputs are shared and applied (Chircop et al., 2020). However, there may be tensions within HE between this instrumentalist strategy and a more liberal strategy to HE transformation.

CBL appears to straddle these two strategies by both providing collaboration with industry and a holistic challenge solving approach that emphasizes personal understanding and reflection.

Recommendations

- CBL practitioners should engage with extra academic actors to identify real-world challenges.
- Extra academic actors should be involved in the CBL process from inception to evaluation.
- Real-world challenges should be aligned with the competencies required by employees.
- The identification of, and support for, CBL should be seen in the wider context of developing symbiotic relationships between business and HEIs.
- CBL activities should encourage personal reflection following real-world analyses.

Inter/Multidisciplinarity

> By 2050, we have fully acknowledged that humans are embedded within ecosystems and that we are ecological, not just social, beings. We have dissolved the boundaries between the 'natural' and 'social' sciences, and all curricula and pedagogies are now firmly grounded in an ecological consciousness.
>
> (Common Worlds Research Collective, 2020, p. 3)

Solutions to real-world, global challenges require multidisciplinary thinking and the bringing together of students and teachers from different backgrounds, industries, and skillsets. Multidisciplinarity has been highlighted in many CBL case studies as a key characteristic of its implementation and success (Membrillo-Hernández et al., 2018; Serrano, Molina, Manrique, & Bajo, 2018).

HEIs have traditionally been siloed into disciplines, but there is need for more complex, holistic, and critical thought to address global societal challenges. Challenges of this type are often, by their nature, complex and multidisciplinary. Multiple viewpoints and perspectives from a variety of disciplines can facilitate

innovation, problem-solving, and new research directions (James Jacob, 2015). Many institutions are now providing a broader range of interdisciplinary courses in response to this need (Berasategi et al., 2020), and academic teachers report that they expect the levels of multi- or interdisciplinary courses to increase in the future (Lyall, Meagher, Bandola, & Kettle, 2015). Employers are also seeking professionals with the ability to solve problems from a multidisciplinary viewpoint (Félix-Herrán, Rendon-Nava, & Nieto Jalil, 2019).

However, there are many barriers and challenges to implementing multidisciplinarity in HEIs; organizational culture, management bureaucracy, greater effort and time commitment, communication across departments, coordinating approval for modules, and logistical challenges (Lyall et al., 2015). These barriers are not only structural but may have an impact on the pedagogical delivery of CBL in institutions.

Supporting multidisciplinarity in teaching requires unique pedagogies and support, of which CBL can facilitate. CBL has often been defined as a multidisciplinary approach (Binder, Nichols, Reinehr, & Malucelli, 2017; Cheung, Cohen, Lo, & Elia, 2011) and has used students or teachers from multiple disciplines in their implementation (Da Costa et al., 2018; Eraña-Rojas, López Cabrera, Ríos Barrientos, & Membrillo-Hernández, 2019). Given the potential increase in multidisciplinary teaching in HEIs in the future, CBL is in a strong position for supporting this type of teaching.

Recommendations

- CBL practitioners should aim to integrate teaching staff and students from multiple disciplines. This will align with both best CBL practice and future trends in HE teaching content.
- Students should be given basic knowledge about multi- and transdisciplinarity and its importance for solving challenges at the start of a CBL program.
- Disciplinary terminology should be clarified throughout as students may come from different disciplinary backgrounds.
- Support for teachers working in a multidisciplinary space should be provided throughout CBL activities.
- Institutional barriers to working across disciplines, and any barriers, should be considered at the course design phase.

Innovation and Creativity

> Future economic growth and social progress in knowledge societies rely increasingly on innovation.
>
> (Hoidn & Kärkkäinen, 2014, p. 5)

Innovation and creativity as competencies have made significant inroads into HE curricula and sparked considerable interest in recent times (Cuenca et al., 2015; Sandri, 2013). CBL-based teaching often highlights these competencies in course descriptions, learning objectives, or skill acquisition (Díaz Martínez, 2019), and similar approaches such as problem-based learning and project-based learning frequently include innovation skills in their design. CBL facilitates innovation skills development such as critical thinking, problem-solving, communication, technical skills and social skills, and innovation ties with many other key characteristics of CBL including multidisciplinarity, technology, collaboration, and flexibility.

Aside from their inclusion generally in CBL teaching, innovation is crucial for meeting the demands of economic change, workplace challenges, and a globalized knowledge economy.

HEIs are encouraged to focus on innovation with the growth in funding opportunities such as the European Institute of Innovation and Technology (EIT) Knowledge and Innovation Communities (KICs). This particular initiative seeks to create partnerships "to find solutions to major societal challenges in areas with high innovation potential" (European Institute of Innovation and Technology, n.d.). The rise in collaboration with industry within HEIs is another marker of the importance of innovation and creativity as future competencies required by students and facilitated by CBL.

Recommendations

- Identify where innovation skills are being taught in existing HEI curricula and aim to integrate CBL in some form within these curricula.
- Use innovation competencies and skills as part of CBL learning objectives.
- Include a range of industry collaborators from multiple disciplines to increase innovative skills in students.
- Consider how teaching innovation skills can be linked to or designed within other key CBL competencies such as collaboration, technology, and multidisciplinarity.
- Partner with institutional TEL offices to keep abreast of new changes in educational technology.

Collaboration

> …our universities cannot fulfil their limitless potential without collaboration – collaboration between institutions, with industry, and across borders. In particular, partnerships between universities and industry will be vital as nations seek to re-build their

> economies after the devastation of the pandemic – re-skilling the workforce and rebooting the knowledge economy.
> (Times Higher Education Consultancy Report, 2021, p. 3)

Collaboration with HEIs has become omnipresent; HEIs have moved from being single closed entities, to active partners with industry, civil society, the general public, and other academic institutions. For HEIs to maintain competitiveness, they need to engage with external actors through industry and academic partnerships, attracting international students, interinstitutional educational collaborations, and extra academic actor input into curriculum design. These types of collaborations at a university level are being reflected in teaching and learning pedagogies such as CBL.

In effect, collaboration within CBL can be conceptualized both within the educational intervention itself, and at a macro level by HEIs and external institutions generally. For example, within CBL activities, collaboration between students, academic teachers, and extra academic actors is a key competency encouraging industry specific skillsets and a deepening of student knowledge. CBL promotes the use of a wide range of industry, civil society, and government actors to engage with students on challenges. Using many different stakeholders during challenges is key to providing wide-ranging, relevant, and practical solutions. However, this type of teaching approach is not only beneficial for students and their employability but also promotes the development of networks and collaborations for the university itself.

To ensure the future profitability of a university, both in terms of economic and research outputs, collaboration is a definitive requirement. CBL can be the framework to develop and maintain these collaborations.

Recommendations

- Integrate CBL into the strategic plans of HEIs where collaboration and networking are mentioned. This will support further development and usage of CBL within courses.
- Structure collaborations with extra academic actors at a high level (i.e., above departments) where all schools and faculties can avail of collaborations.
- Integrate extra academic actors into alumni networks, so that students can maintain relationships with them after their course has completed.

Technology Enhanced Learning

> The past year's disruptions and rapid changes, which forced so much of teaching and learning to be done remotely, have made digital technologies even more vital to higher education. What those technologies are, how they are deployed across the

> institution, and the ways in which they themselves continue to evolve may very well be one of the defining stories of higher education in the years ahead.
>
> (Pelletier et al., 2021, p. 8)

Referring to the rapid change to TEL during the COVID-19 pandemic in 2020, the preceding quote summarizes how evolving and open-ended the future of HE can be. Technology can be a means of rethinking and reframing HEI educational missions (Burbules, Fan, & Repp, 2020), but up until 2020, integrating technology for teaching and learning was often a slow process with limited uptake in some more traditional institutions.

The global pandemic (World Health Organization, 2020, p. 72) forced the physical closure of most HEIs globally in March 2020. As a result, HEIs made sudden changes to their teaching and learning practices including a rapid move to online teaching, redevelopment of assessment practices, and changes to student support (Crawford et al., 2020). A positive development of this change in practice is how many teachers are now better prepared and trained in TEL. However, there has been a very broad range of TEL approaches across HEIs, from fully redeveloped curricula to more basic "emergency remote teaching" approaches. As such, single scenarios for TEL will not fit every institution which can be a barrier for implementing new teaching and learning approaches.

A major benefit of CBL which supports application across all HEIs is its open and flexible nature; many TEL methodologies, platforms, and instructional design approaches can be easily interwoven with CBL frameworks.

Currently there is little evidence of how effective CBL can be in fully online or hybrid modalities though there is emerging evidence, from CBL courses that transitioned online due to COVID-19. These preliminary studies could inform the design of online and/or hybrid CBL in HE. We expect many studies to emerge because of the massive shift to online learning due to the COVID-19 pandemic, providing insight into the development of CBL across delivery modalities.

A CBL program at the Politecnico di Milano that moved online due to COVID identified three main CBL drivers (interaction, motivation, and engagement) which were significantly diminished (Colombari, D'Amico, & Paolucci, 2021). Interaction between the student and a range of stakeholders is a key part of the CBL experience, yet online communication was reported to be less authentic and less effective. The sense of increased formality in online interaction also diminished informal learning. Similarly, the online modality negatively affected the engagement and motivation of students who felt more apart from the challenges.

These negative impacts were ameliorated by the emergence of some benefits of conducting CBL online. Students reported feeling less rushed and more able to engage reflectively with the process. They were able to benefit from the advantages of TEL such as rewatching video resources and the ubiquitous nature of hybrid learning (Colombari et al., 2021).

It is apparent that some aspects of online learning can directly benefit CBL. For example, the creation of globally distributed teams of students who can

interact with appropriate stakeholders from across the globe would enhance the global/local dimensions and access to the authentic stakeholders and actors with regard to challenges (Gibson et al., 2018).

What is emerging is not a dichotomous situation where CBL can work in either an online or a face-to-face modality or on a spectrum with hybrid learning in the middle. But, rather, CBL designs that consist of an intermingling of techniques, technologies, and pedagogical strategies that align with and support the goals and objectives of CBL. As with all pedagogical strategies, the best CBL design will represent the thoughtful and meaningful integration of technology-enabled delivery modalities, activities, and assessments where appropriate for the learning objectives for the students.

Recommendations

- Ensure that teaching staff have support and training in TEL prior to commencing CBL.
- Accessibility for technology tools should be highlighted as a priority for facilitating inclusion for all students and extra academic actors.
- Innovations in TEL should be connected to CBL processes during the curriculum development stage.
- Support and training for students should be a priority when new technologies are used in CBL.
- Accessibility considerations for students and teachers should be determined at the course development stage.

Flexibility

> …as the world changes our pedagogies must also find new forms to help learners not just to react to current trends or to repeat dominant patterns of thinking but to be capable of responding constructively and pursuing alternatives.
>
> (Ryan & Tilbury, 2013, p. 9)

Although CBL has definitional challenges, perhaps an unintended benefit of this is its flexibility in terms of pedagogical innovation and interpretation. Many applications of CBL in HE use hybrid forms, such as combining CBL and design thinking (Gama et al., 2019), CBL and agile practices (Santos, Sales, Fernandes, & Nichols, 2015), or CBL and game-based thinking (Siqueira da Silva, 2018), among many others. Strict adherence to a single CBL framework is uncommon, and many educators implement a range of short-, medium-, and long-term challenge-based activities depending on how they may fit into their curriculum. This flexibility can strongly support its integration into new HEI and aligns itself with future pedagogical and curriculum design trends.

For example, in many countries, the realities of a rigid, one-way learning system has been highlighted, and education systems require transformation to be more flexible with multiple pathways, self-assessment, and integrating different stakeholders (Inayatullah, 2020). Personalized learning, another key trend in education, where teaching and learning is focused on the needs, potential, and perception of a learner (UNESCO, 2017) is easily visible in CBL approaches; the student chooses their challenge, are given ownership over their learning, and technology-enhanced resources allow for students to build their learning pathway at their own time.

The flexible application of CBL across all disciplines, curricula, and teaching environments appears to be able to support this future transformation. On the one hand, this bodes well for the future applicability of CBL in HE as the approach can be molded to fit many different educational needs; however, it could also further fragment the definition of CBL which could be its downfall in terms of legitimacy and academic support.

Recommendations

- HEIs should consider CBL as a guiding framework which can be used in different educational programs in different ways to achieve personalized student learning outcomes.
- Educators who are reluctant to make significant changes to their curriculum should be encouraged to implement small, short-term CBL approaches, integrated with their existing teaching method, as a way of gently introducing them to the approach.
- Academic Practice departments should explore and document how CBL could be integrated into existing pedagogical frameworks used in a HEI.
- Simple guidelines for educators which align institutional pedagogical practices with CBL should be produced to support the integration of CBL in teaching and learning.

Challenge Definition

> [CBL]… called for a new way of thinking about the role of the teacher, one in which he or she had to be comfortable as the students struggled and wrestled with a meaningful challenge, letting them choose their own path to understanding within a clearly global issue like sustainability, global warming, or war, and ultimately allowing them to come up with both questions and answers as they directed the course of their own learning.
>
> (Johnson, Smith, Smythe, & Varon, 2009, p. 2)

The overarching element for all of these CBL characteristics, and the defining characteristic for CBL is the challenge; a broad statement or task as a means of encouraging students to address educational criteria, fulfill competencies and complete learning objectives (Gibson et al., 2018). In CBL research, two approaches are common; giving students the tools and structure necessary for developing their own challenges, or providing a challenge for students to solve (e.g., in a Hackathon format). The broad definition of CBL allows for both approaches, but it could be argued that a student-centered approach to challenge definition encourages greater development of skills and competencies required by HEIs, industry, and future trends. In any case, using a challenge as the basic unit of instruction in HE is growing, but more research is needed as evidence for their success in addressing student outcomes (Nowell et al., 2020).

Challenges defined by students in CBL activities can be conceptually linked to the challenges facing HE today; digital and green skills acquisition, the need for TEL, the drive toward multidisciplinarity, the emergence of innovation as a key competency for students, the reimagining of pedagogy as flexible, the greater focus on collaboration both for HEIs and for students themselves, and ultimately, the importance of providing students with real-world experience and the skillset to face grand global challenges.

Recommendations

- Encourage students to define their own challenges rather than providing challenges for them.
- Engage in evidence-based research evaluating CBL to support its use.
- Consider how challenges fit within the broader challenges facing HE and how they can be used to future-proof student careers.

Future Directions and Conclusions

As we have seen, CBL is strongly intertwined with future trends in HE. We can summarize these future directions as follows:

(1) The COVID-19 pandemic has resulted in HE globally pivoting to online and heavily blended delivery modes to ensure ongoing delivery of education. While much of this has been in the form of emergency remote teaching more than the considered application of technology or measured exploration of alternative delivery modalities, it is likely that the episode will have an ongoing impact and reevaluation of how pedagogies can be delivered. CBL is well placed within this future pedagogical space.
(2) Most of the published academic literature on CBL is in the form of case studies of implementations (Gallagher & Savage, 2020). While useful, case studies have challenges in both generalizability and theory generation. To further develop CBL to support the future of HE, there is a need to conduct more theoretical work to establish the mechanisms at play.

(3) We have demonstrated the appropriateness of CBL for the future of HE; however, we have not addressed the change in teaching practice that would be required by the academic community as this is out of scope of this chapter. Existing literature on change in practice does require an evidence base that demonstrates the impact of student outcomes in order to change teaching beliefs among faculty (Guskey, 2002).
(4) Current implementations of CBL focus on specific disciplines, in particular engineering. This poses a challenge not only to interdisciplinarity but also to broader adoption of CBL in other disciplines. The risk is that CBL is viewed as a pedagogical approach that is valid only to specific and STEM-focused disciplines.

In addition, the overarching importance of CBL evaluation is crucial for its future within HE. CBL evaluation should explore competencies and knowledge acquired, types of global themes addressed, levels of cooperation between CBL actors, and general perceptions from students and teachers. However, for CBL to be recognized within HE structures and research, clear planned, structured processes and replicable evaluation methodologies are required. This can be challenging because of the wide range of CBL delivery methods and tools (Conde et al., 2019). Often bespoke frameworks or assessment instruments are required which adds to the workload of teaching staff or the proliferation of divergent or convoluted evaluation strategies. However, it is through evaluation that the power of CBL for the future of HE can be validated by the community at large.

A potential solution to streamlining CBL evaluation is to use its key characteristics, either individually or as a collective, to scaffold evaluation strategies. This would support the alignment of CBL with future directions in HE identified in this chapter. Future research should investigate key evaluation characteristics that could be applied to any CBL approach, that perhaps align with CBL characteristics at a broad level.

Conclusion

This analysis has argued that CBL will become more relevant and applicable to future teaching and learning due to its alignment with many of the future trends evident in HE. The common characteristics of CBL appear to address many future challenges and should be integrated, in some form, in HE curricula. The flexibility of CBL allows for this integration to be small scale, such as including a student-centered challenge within larger teaching activities, or large scale, across an entire program.

The path of HE is always unknown, and trends are never definitive. Unanticipated barriers and challenges will always emerge, but new pedagogies and processes should aim to align primarily with the needs of students. These needs should be taken into account with the broader societal, economic, and educational trends. Educators must constantly reflect on how their teaching is relevant and engaging, and how they can best support critical thinkers and skilled students

for their personal and professional development. Our recommendations are a starting point for this, not only for current CBL practitioners but also for those starting out on their CBL journey.

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