When doing challenge-based learning, you need critical morality to contribute to societal challenges

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***Abstract*—With Challenge-Based Learning (CBL), universities aim to explicitly contribute to societal challenges, mostly involving moral dilemmas. As such, students, teachers, university management, and external stakeholders get morally involved in societal innovations. We analyze the existing CBL literature on this involvement in three dimensions, e.g., personal, interpersonal, and collective. We find that all three levels are present but that the criticality needed for societal challenges is discussed less explicitly in the CBL ethics literature. As a first step to answer this gap, we explore instances of how CBL programs of Mbarara University of Science and Technology (Uganda), Eindhoven University of Technology (the Netherlands), and Tecnólogico de Monterrey (Mexico) are confronted and deal with this criticality. We conclude that it is fruitful for further research to look into the strengths of CBL to engage students in real-life moral experiences continuously and that more research on critical morality at the personal, interpersonal, and collective dimensions is necessary for CBL as a pedagogical method for universities to contribute to societal challenges.**

Keywords— Morality, challenge-based learning (CBL), lived experience, system, criticality.

I. Introduction

Engineering education aims to prepare students to deal with contemporary societal challenges that require comprehensive solutions. This requires both technological and moral competencies. Engineering education uses experiential learning methods, such as Challenge-Based Learning (CBL) and its implementation [1], to continuously engage students in real-life processes to teach them about solving contemporary technical challenges [2], [3], [4], [5]. With CBL, universities also aim to contribute to societal challenges [6], [7]. As such, students, teachers, university management, and external stakeholders get morally involved in societal innovations [8], [9], [10]. We perform a literature review on (“ethics” or “morality”) AND (“CBL” or Challenge-Based Learning” or “Challenge Based Learning”). We analyze the existing CBL literature on this involvement in three dimensions, e.g., personal, interpersonal, and collective. We find that all three levels are present but that the criticality needed for societal challenges is discussed less explicitly in the CBL ethics literature. As a first step to answer this gap, we explore instances of how CBL programs of Mbarara University of Science and Technology in Uganda, Eindhoven University of Technology (the Netherlands), and Tecnólogico de Monterrey (Mexico) are confronted and deal with this criticality. We conclude that it is fruitful for further research to look into the strengths of CBL to engage students in real-life moral experiences continuously and that more research on critical morality at the personal, interpersonal, and collective dimensions is necessary for CBL as a pedagogical method for universities to contribute to societal challenges.

II. Challenge Based learning

CBL is a pedagogy that introduces real-life problems and challenges in education and shares common learning principles [1], [11]. Classically, students do a project in a team for stakeholders. These stakeholders are developing sociotechnical innovations and, of course, do not know where this ultimately will bring them. As such, CBL aims to link students' academic knowledge with professional practice by introducing students to problems, tasks, or challenges relevant to their future practice [12], [13]. Students learning in CBL is contextual, self-directed, and collaborative [13], [14] In CBL, challenges are not fully predefined. Multiple socially relevant wicked problems can be identified within a given challenge, and learners are considered as co-creators of solutions [8], [15].

For example, CBL drives students' knowledge acquisition through engagement in real-life contextual challenges that lack a predefined solution. Challenges in CBL are sociotechnical, meaning they are not purely technical problems but socially relevant challenges [10], [16]. The scope of challenges in CBL is real-life, open-ended, ill-defined, and involves stakeholders [4], [16]. CBL motivates students [17]to work collaboratively with peers and external stakeholders to define the problem within the broader challenge they want to tackle and develop solutions while considering the ethical and practical implications of this solution flexibly and iteratively [18].

Developing solutions for real-life challenges and problems requires that students first consider the particularities of the social, cultural, and historical situation of the challenge when making ethical decisions. Students are invited to develop their moral agency to identify and address ethical challenges in their communities or society. CBL is activating in that it invites students to be co-creators in a process and actively engage in innovation processes. By working collaboratively with their peers, teachers, and stakeholders and by engaging with their diverse perspectives, students can learn to identify the underlying ethical issues in a challenge, explore alternative solutions, and evaluate the potential consequences of their proposed solutions. Through CBL’s learning principles, such as problem orientation, contextual, experiential, and collaborative learning, and student-centeredness, it creates the conditions for continuous engagement in real-life experiences and learning processes capable of impacting engineering student morality.

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In this chapter, we consider "ethics" as "the systemic reflection of morality" [19](p332), and morality as "a totality of opinions, decisions, and actions with which people express, individually or collectively, what they think is good or right" [19](p334). Morality requires a continuous engagement in practices and lived experiences which we will call "enactment".

We will define three levels of moral enactment. The individual dimension refers to how individuals form opinions and make moral decisions. The interpersonal dimension refers to how moral interactions between individuals are shaped. And the collective dimension refers to the cultural aspects of institutions or broader societal norms that impact the moral enactment.

III. Three Examples of CBL Programs

We will first give three examples of CBL programs. The first is Mbarara University of Science and Technology in Uganda, which does not have a CBL program, but is considering starting it as it already has strong collaborations with students and companies in the ecosystem. Eindhoven University of Technology in the Netherlands started about 6 years ago with its CBL program with experiments at individual course level and recently implemented CBL more formally in the curriculum. Tecnólogico de Monterrey in Mexico has a long tradition of CBL, and has CBL throughout the curriculum. As these three universities have different levels of implementing CBL in their curriculum and as they are in different continents, we think that they present a broad yet concise list of universities that can be used as examples.

A. Mbarara University of Science and Technology (MUST)

A first case example is the Mbarara University of Science and Technology (MUST) in Uganda. The implementation of CBL has not yet been formalised at the university level; however, isolated implementations at the course level are observed. Engineering ethics is taught during the second semester of the final year for the six engineering programs at the Faculty of Applied Sciences and Technology (FAST) at Mbarara University of Science and Technology (MUST). The focus of this course is on examining and evaluating the meaning of ethics and professional conduct. A guiding theme in this course is the human search or quest for values and ethical direction regarding professional conduct and our daily life relationships with others. This is in line with enacting morality at the personal, interpersonal and collective dimensions. Students are expected to articulate and evaluate their ethical principles and values and their foundations. The first part of this course covers the nature of ethics, ethical development, responsibilities and basic ethical directions such as utilitarian ethics and various views of justice. In contrast, the second part of the course covers specific business and engineering ethical issues such as the company's and engineer's ethical obligation to the public, employer-employee ethical obligations, including such topics as the giving and receiving of gifts, employee theft, trade secrets, computer ethics, fair wages, safety, working conditions, job satisfaction, employee rights with particular emphasis on whistle-blowing, the ethics of political tactics to advance one's career, and discrimination and affirmative action. Also, emphasis is given to environmental ethics, including such topics as pollution control, the conservation of natural resources, various ethical positions on the environment, biomedical ethics, the treatment of animals, and the ethical assessment of new technologies.

B. Eindhoven University of Technology

Eindhoven University of Technology (TU/e) in the Netherlands has a history of six years working with CBL at a small, experiential level. It is currently making the next careful step in extending CBL to all students for a few courses in the curriculum. Eindhoven University of Technology (TU/e) is a relatively young university founded in 1956 by industry, local government, and academia. The ecosystem collaboration has been seen as core to its identity from the beginning onwards and is still considered an essential characteristic. The website mentions centrally, "Together with other institutions, we form a thriving ecosystem with one common aim – to improve quality of life through sustainable innovations." 1 TU/e's Bachelor College has dedicated the previous ten years 20 of its 180 ECTS explicitly to ethics and social sciences courses to make students aware of the societal aspects of technology [20]. It also experimented with CBL courses, including courses on ethics, on a relatively small scale for five years up until now. For this, from the beginning onwards, it offered support to volunteering teachers in terms of support of teaching assistants. It provided financial funding if needed (development of tools, extra materials, etc.). After a few years, the makerspace "Innovation Space"2 further elaborated the support for teachers in doing CBL. It took up the role of a hub for collaborations between university and ecosystem partners and organized the availability of suitable classrooms.

C. Tecnológico de Monterrey (Tec)

Tecnólogico de Monterrey (Mexico) has implemented an innovative educational system in all careers, the TEc21 model (Membrillo-Hernández et al., 2021) that involves four fundamental pillars. The first refers to a flexible education that allows students to decide on face-to-face or distance classes. Second, the teachers should be inspiring, trained teachers with a new mindset that allows them to change their type of teaching for experiential and active teaching. Third, the university experience for students should be of excellent quality that results in a memorable experience as a stage of comprehensive education. As the fourth pillar, all education from the first semester is carried out with the learning technique based on challenges in the presence or absence of training partners that, together with teachers, design attractive challenges for students, teachers and partners s trainers who participate. The Tec21 model has shown so far that the skills developed by its students attest to the pedagogical, cognitive, and experiential learning structure of high development of both transversal and disciplinary skills.

Tecnológico de Monterrey considers ethics as a transversal competence that applies to all courses but leaves it in the hands of teachers (technicians). There is no real control over how much ethics students work in a full curriculum. However, ethics has been implemented as a dynamic concept

[1] https://www.tue.nl/en/our-university, retrieved April 23, 2023.

[2] https://www.tue.nl/en/education/tue-innovation-space/, retrieved April 23, 2023.

that becomes a competence of immediate application. Mainly, it is suggested that teachers implement ethical dilemmas in their courses and be part of challenge-based teaching.

IV. The Individual Dimension of Lived Moral Experience in CBL

At the individual dimension of enacted morality, we look at how individuals form opinions and make moral decisions. We analyze how the literature on ethics in CBL describes the individual aspects of universities contributing to societal challenges [21].

First, teacher-centered education is considered lacking in confronting students with real-life ambiguity [13],[18]. CBL encourages students to take a proactive and collaborative approach to ethical problem-solving rather than simply memorizing theories and applying them to detached ethical cases [22], [23]. A second reason mentioned is motivation. Not all engineering students are intrinsically motivated to study engineering ethics education and try to avoid deep learning. Research shows that students' engagement is increased. Also, their basic needs, autonomy and competence (not relatedness) are influenced positively in CBL ethics education. CBL can satisfy students' basic needs and promote intrinsic motivation [8], [23].

CBL is said to add to transversal competencies. CBL helps students to know themselves [24] and increase personal awareness by reflecting on their values [4], [25] or via constructive or destructive friction between student and teacher regulation [26]. CBL helps students to increase their self-regulation [27] and resilience to failure [2], problem-solving and critical thinking [24], [28]. It improves communication competencies [8] and a collaborative attitude in ethics [24], [28], as well as an understanding of the broader societal context in which engineering and technology are practiced [16], [23].

When the ethical learning in CBL is assessed, it is mentioned in different ways, as a general subject of knowledge [10], [18], an understanding of micro- and macro-ethical understandings [9] or the application of value-sensitive design [4], [9]. Ethical learning in CBL also refers to ethical competencies, such as moral sensitivity [29] and contextual and ethical awareness [24]. [23] studies how students' decision-making in finding an ethical solution to a real-life case and how they form a judgment of their decision-making.

This overview illustrates that CBL, as a continuous engagement in real-life experiences, strongly stresses the practices and lived experiences as an active way of experiencing morality in terms of motivation, engagement, self-knowledge, self-regulation, communication competencies, moral understanding, awareness and ethical decision-making. However, it is not really addressing critical moral attitudes. It refers to critical thinking and friction but does not elaborate on how this adds to enacting this critical aspect of morality. It leads to an impoverishment of engineering ethics education when it uses pedagogical approaches that do not apply morality enactment.

The limitation of this paper does not allow us to develop critical thinking and friction further. However, we want to give a few instances of how CBL programs deal with friction at the individual dimension for students and teachers.

CBL can help students reflect on their moral stance in a direction that teachers or the university prefer. However, which option or direction the individual student opts for remains the student's moral choice. This might create tension for the teachers. Also, at TU/e and Monterrey, specific tensions are reported to be inherent to ethics in CBL. The continuous engagement in real-life experiences of morality in the CBL course comes from the engagement that a real case allows for, the ambiguity that students are confronted with, and the in-depth coaching students receive to find their way to find a solution for the challenge and the self-reflection on their learning. Of course, "What ethics is "good"?" remains. If students say, "In this project, we want to make much money and do not care about the environment." or even worse , "We do not care about the racist aspects of design as our technology is only tested on white male people.", it is clear that as a teacher you want to find a balance between the autonomy of the student and stressing values that are your own and commonly shared. The same applies to stakeholders. Some stakeholders are engineers and answer the ethical questions of students with "That is not my expertise, I am an engineer". Therefore, a CBL course that includes ethics can be a solution to "screen" external stakeholders so they do not bring an opposite message to the one you want to give as a teacher.

Mbarara University asks students to reflect on their attitudes and strengths to go against bribery and corruption in their country. For sure, this creates friction, as becoming an engineer for many students is essential in the intellectual and financial development of themselves and their families. However, getting and keeping an engineering job might require them to conform to the company culture sufficiently. Therefore, ethics is examined through class assignments where students are asked to reflect on a case study within the local environment with a focus on what they would do differently regarding the unethical conduct exhibited in cases as bribery/corruption, expected to find in the news especially concerning hacking of financial institutions. civil works of collapsing buildings, broken roads and bridges that are a result of poor workmanship by the engineers on site. Moral enactment is emphasised through the university exam regulations, where students are expected to exercise ethical conduct and not indulge in exam malpractice. An example is when a student decided to whistle-blow and report tactics used by his classmates in exam malpractice, risking being rejected by his classmates for it. This was an exhibition of choosing to do the right thing at the expense of staying popular.

V. The Interpersonal Dimension of Lived Moral Experience in CBL

Morality is not only personal; it is also interpersonal. The literature on CBL and ethics mentions interactions between students; and between students, student teaching assistants, teachers and external stakeholders. We analyze how the literature on ethics in CBL describes the interpersonal aspects of universities contributing to societal challenges.

CBL encourages moral student-student collaborations, both in open and structured settings [30], [31]. As CBL requires an interdisciplinary perspective, students are often encouraged to form teams with peers of diverse skills and backgrounds (or simply "put into" interdisciplinary teams). Collaborative work [24], [28] in ethical situations is emphasized. However, these authors do not underline how this collaboration leads to a moral demand and how a particular importance on collaboration could increase this. CBL also

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provides an intense experience to reflect and provide feedback in an in-depth way. Through these learning activities, students can develop their ability to reflect on their values but also make explicit the core interpersonal interaction as a source of morality. Focusing on this in intensive feedback sessions is time-consuming [32]. When CBL ethics education is remote, the moral imperative in communication in general and feedback in particular is even more vulnerable [7].

CBL brings in student-stakeholder collaborations. Students need to research to understand the ethical issues revolving around the challenge. This could involve reviewing academic articles. Using their research, students develop a proposal that outlines their approach to the challenge and the ethical principles that guide their decisions. The proposal must be well-reasoned and articulated and demonstrate the student's understanding of the ethical implications of their decisions. Students then present their proposal to their peers, teachers and external stakeholders/industry partners and defend their solution by clearly communicating the ethical principles and practices that guided students' decision-making. By engaging with these dilemmas, students can develop their decision-making skills and apply ethical principles in complex situations in concrete interactions with external stakeholders. This can help students develop their ability to communicate effectively with different groups and to understand and respect different perspectives.

CBL also impacts the student-teacher collaborations. The need for uncertainty and complexity at the classroom level [2] makes teachers decide on structured and open CBL approaches [31]. Is it reasonable to have very open approaches, probably leading to students' feeling lost [33] and being more stretched or more structured approaches in which students learn step-by-step from their comfort zone? Both open and structured approaches are morally valuable but different.

CBL also influences teachers-stakeholders collaborations. Teachers must approach potential external partners and maintain fruitful cooperation [34]. The stakeholders are often close to the teachers' research. When implementing CBL in ethics education, teachers need to consider, first of all, what constitutes a relevant challenge for their students. [10] therefore stresses that teachers need an adequate training program and support on assessment instruments. The transformation of teachers to adopt CBL should be performed carefully [28]. As staff also perceive a higher workload in CBL courses [8], the extra work put in CBL should be compensated. It can be the teacher's responsibility to look for solid links between CBL education and personal research (bringing in the ethics of using students as cheap labor for research), but also at the university level to consider differences in the student-teacher ratio between CBL and more teacher-centered courses.

This brief overview shows that several interpersonal moral aspects are mentioned in the literature, but a full potential of moral interaction is not strongly developed.

At Mbarara University, morality enactment is emphasised by requesting students to evaluate themselves and their peers during group work by filling out an evaluation form. It is at this stage that the project supervisor begins to see behavioural and moral dynamics among the students. The supervisor must trace for signs of unethical conduct, such as marginalisation within the group and discuss with individuals and the entire group, respectively, based on the evaluation scores on their moral values while doing group work.

Morally constructive critical instances happen continuously. Students, teachers and external stakeholders are confronted with their general views when critically interacting with others. Students are confronted with engineering work, but also engineers are confronted by students. We can report on a stakeholder discussing a multi-million project on lighting on a ringway to improve the quality of life at TU/e. Students considered this window dressing and, as a group, made this clear to the stakeholders. Consequently, the stakeholders had to admit to the class group that this was indeed something they were, as a company, struggling with. Tensions also arise when companies approach a teacher or university with specific requirements that are not in line with the fundamental values of the university. At TU/e, a large tech company offered educational materials and financial benefits for CBL in exchange for merchandising and use of the company's products by the teams. At Tu/e, this was discussed with the ethical review board, which formally considers CBL projects anyway. Here, together with the management, it was decided not to embark on the company and its challenge as the company profit was seen as opposite to the student learning. For teachers, this also raises the question of how much the confrontation should be looked for to use this confrontation potential by, for example, reaching out to societally critical actors such as "University Rebellion" or companies with a societally debated history, such as established fossil fuel companies.

As students at Monterrey have to solve real and current challenges, they use the latest innovative tools to solve the challenges. These are, by definition, multidisciplinary, where several experts converge and become part of the student team to solve them. Due to the complexity of the academic program, the ethics of the challenge itself, the ethics of the methodology to be used, and above all, the ethics in the procedure of its resolution or in its planning itself are overlooked. Furthermore, if the challenge is designed or proposed by a training partner, in many cases, they are not reviewed by an ethics committee that determines the suitability of the challenge. What if it does not comply with any regulations? Or does it put the population at risk? Or does it constitute a breach of the current regulations? We can develop fantastic didactic models, but if we do not consider their ethics, there would be no reason to carry them out. These considerations go beyond academic integrity and must be observed by all the professors involved to decide whether or not the challenge can be carried out as proposed and make the necessary adjustments. For example, a recent challenge had to do with Architecture students who had to design roofs for houses in vulnerable, impoverished communities. The CBL Technique was excellently designed. However, the execution of said models and the implementation of roofs involved the promotion of irregular human settlements. This contradicts the current urban development law, which stopped all academic procedures and decided on another challenge. If there is no exhaustive review by an ethics committee, we could be solving challenges that do not correspond to the legality of a community.

VI. The Collective Dimension of Lived Moral Experience in CBL

The collective dimension of morality enactment refers to the cultural aspects of institutions or broader societal norms that impact the moral enactment [35]. We analyze how the literature on ethics in CBL describes the collective aspects of universities contributing to societal challenges.

CBL impacts internal university management culture. Working with industry partners can help to prepare students for the ethical challenges they may face in their future careers as engineers [16], [36], [37]. Collaboration with industry partners gives the university the possibility to develop its education further and use the challenges as a driver for students' learning [36]. CBL is seen as a method to engage students as co-creators [8] in which industry partners can offer insights into the latest trends and technologies and provide guidance to universities on how to make research more relevant to industry needs. Collaborating with industry can be beneficial for the profile of the university, which subsequently can attract more funding, partnerships, and talent to the institution [38], [39]. Universities can use their CBL programs to position themselves in national and international educational networks. They can use this to attract more students.

CBL also introduces organizational challenges. The role of quality control in ethics education should be strongly reconsidered as many aspects require adaptations, such as learning objectives and assessing whether students achieved them [40], [41]. Suppose CBL is seen as a separate approach that, for example, also allows for another student-teacher ratio. In that case, there is a need for demarcating if certain ethics approaches are or are not CBL level [11]. The most challenging internal management decisions on CBL are its financial feasibility and scaling [42], as many universities only experiment with miniature CBL courses that remain relatively expensive.

CBL impacts internal stakeholder management. Collaboration with industry partners is not only beneficial for student learning. However, it can benefit the university as an organization, for the stakeholders and even for the entire ecosystem and its co-creation processes. Next to the core (technical) aims of stakeholders, morality is involved in the culture and culture change. Collaboration with university projects provides industry partners access to talented students, researchers, and faculty members who can bring fresh perspectives and new ideas to their organizations [43], [44]. These collaborations can lead to innovative solutions to complex problems and challenges. Through this collaboration, industry partners can also access cutting-edge research and technology that helps them to remain competitive and innovative in their domain [44]. Participating in CBL projects can also have a positive effect on the reputation of industry partners by demonstrating their commitment to research, innovation, and education [43]. This can help them build positive relationships with customers, investors, and employees. Finally, collaboration with university projects can be a cost-effective way for industry partners to address complex problems and challenges by leveraging the resources and expertise of the university, leading to more cost-efficient and practical solutions [44].

CBL, however, also impacts the universities' and stakeholders' societal responsibility. While working on broader and more complex challenges with a societal focus, students can develop a sense of social responsibility and a commitment to using their skills to make a positive impact in the world. However, when CBL is an integral part of the curriculum, it can also be a vehicle for universities' contributions to sustainability goals. Solving challenges with strategic partners, governmental organizations, NGOs and individual citizens, CBL experiences will impact the societal role of universities [5].

While collaboration between industry partners and universities can bring many benefits, it is essential to be aware of the potential dangers and to take steps to mitigate them. Universities must ensure that collaborations with industry partners are conducted ethically and transparently and that academic freedom and student learning outcomes are not compromised [43]. CBL also contemplates the appeasement of legal and ethical aspects necessary In a university-enterprise negotiation process [5], [26], [45].

We can conclude that the impact of ethics CBL courses on the collective dimension has already been discussed. However, the critical aspects are far less developed. How do universities and stakeholders enact continuous engagement in real-life experiences in their mutual relations with others and themselves? We describe critical instances of this collective dimension at different levels, such as the university as an organization, the university's ecosystem, the professional engineering community and society as a whole.

The critical collective aspects also relate to the university's ecosystem. Mbarara University works with industry to allocate students internship placements. This begins with the faculty students' internship coordinator and a few other staff soliciting internship placements from companies by paying them a physical visit to establish a memorandum of understanding since internship placements are limited due to the increasing number of institutions offering engineering programs. This could bring into play the power dynamics of which company offers more placements and if that influences how students or the university approaches any controversial issue that may arise in society because of this company. For example, how does a university handle engagement with a soft drinks factory that manufactures drinks that are detrimental to health and does not have good waste disposal practices? Would they expose the harm this factory is doing to the environment through research or conceal it based on the existing collaboration where students find internship placements at the factory? As MUST transitions to CBL implementation in the classroom, the approach of students' projects must be given a perspective that examines more the ethical component that has not been given attention in the past to ensure students regard ethics as a significant component to finding solutions for community challenges. This will involve students interacting with external stakeholders, such as industry players, to tackle the controversial issues affecting the environment. Such interactions made possible by the CBL approach will help enrich the approach of engineering ethics education in the country and hopefully positively impact society. This change will be witnessed with improved engineering projects such as well-constructed roads and bridges that meet international standards. The CBL approach will implicitly address mindset change within engineering instructors and students concerning the importance of engineering ethics to the nation's socio-economic development.

The design of the challenges must comply with current and valid ethical standards. In some cases in Tecnólogico de Monterrey or TU/e, the challenges only respond to the urgent needs of the companies (stakeholders) and ignore the ethical standards of the problem. What would happen if the challenge involves breaking a norm or a local or global law? The challenges would have to go through the evaluation of a committee that verifies the ethics of the problem; at the moment, the teachers are based solely on common sense, which is not necessarily in line with professional ethics. To conclude, there are some lessons learnt. (1) The proposed challenges must be conceived within a frame of reference that respects human rights TM. (2) The proposed challenges must be analyzed by a commission of teachers that validates that they do not violate any legislation or acquired right (Intellectual property, national or international laws). This can be an ethical review board or another committee. (3) If within the development of the resolution of challenges, there is a question to be resolved that implies an ethical dilemma, it should be analyzed with the teachers in charge of the CBL. (4) The existence or not of some type of conflict of interest that could mean the resolution of the challenge or its theme must be determined.

VII. Conclusions

We considered CBL as a method that allows for continuous engagement in real-life methods. We focused on research on ethics education in CBL practices. We analyzed the literature about how moral enactment is described when CBL takes place in universities that aim to use it to contribute to societal challenges. We performed a literature review on ("ethics" or "morality") AND ("CBL" or Challenge-Based Learning" or "Challenge Based Learning") and analyzed the results in three dimensions, e.g., personal, interpersonal, and collective. We showed that all three levels are present but that the criticality needed for societal challenges is discussed less in an explicit way in the CBL ethics literature. As a first step to answer this gap, we explored instances of how CBL programs of Mbarara University of Science and Technology in Uganda, Eindhoven University of Technology (the Netherlands), and Tecnólogico de Monterrey (Mexico) are confronted and deal with this criticality. We conclude that it is fruitful for further research to look into the strengths of CBL to engage students in real-life moral experiences continuously and that more research on critical morality at the personal, interpersonal, and collective dimensions is necessary for CBL as a pedagogical method for universities to contribute to societal challenges.

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