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ORIGINAL PAPER

Walking the Talk on Education for Sustainable Development: The Value of Circular Economy Education in the Age of Complexity

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Abstract
In the wake of contemporary societal grand challenges, the circular economy has emerged as a plausible vision towards a more responsible, resilient and prosperous future. Embraced by several national and supranational policies and espoused by incumbents and innovators in the business context, circular economy thinking has also made inroads in the academic literature. Scholars from across disciplinary fields have contributed to a lively and vibrant research community. However, while education is amongst the systemic conditions enabling the transition towards the circular economy and higher education plays a pivotal role as a global stakeholder, the burgeoning circular economy literature has remained almost silent on how to integrate circular economy into higher education, on its benefits and implications. Based on a course experience in higher education, this article proposes a pedagogical approach for introducing the next generation of business leaders to circular economy thinking and its relevance for flourishing within planetary boundaries. The benefits of this proposal are twofold. From an operational viewpoint, drawing on the i5 Principles for Responsible Management Education Playbook, an open access resource specifically designed for transforming business education and developing more responsible leaders, this article enriches the emerging literature at the intersection between education, the circular economy and the socio-ecological approach to management education and scholarship. From a conceptual viewpoint, it shows that this approach to circular economy teaching is in line with recent calls from higher education scholarship to promote an ecological and imaginative vision of higher education.

Keywords Circular Economy · Systems Thinking · Responsible Management Education · Societal Grand Challenges

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Introduction

The circular economy (CE), with its enticing narrative, has been attracting considerable interest across different stakeholders for its potential to address multiple sustainability challenges and contribute to the achievement of several of the 2015 UN SDGs [1]. Drawing on different schools of thought, the CE is characterised by three core principles: design out the concept of waste (*eliminate*); keep products, components and materials in use for as long as possible at their highest utility and value (*circulate*), and regenerate natural systems (*regenerate*) [2]. Underlined by a sound and attractive economic rationale– it is estimated that a global economic opportunity worth $4.5 trillion exists if CE principles are implemented [3]– start-ups and established corporations from across the globe are experimenting with the implementation of innovative business models based on CE principles. The Circular Start-up Index, an initiative of the *Ellen MacArthur Foundation*, includes more than 700 innovative start-ups from across the globe that are implementing CE principles in their business strategies [4]. At the same time, the *Ellen MacArthur Foundation* is working with the world's leading organisations to accelerate the shift from our current linear economy to the CE [5]. While this is remarkable as business model innovation is a key building block of the transition towards the CE [6], there is a range of system conditions that must co-evolve with innovative business models for a CE to emerge and scale, and specifically, *education*, *financing*, *collaborative platforms* and a *new economic framework* [2]. For the CE movement to inform society through the actions and plans of future leaders, stakeholders and institutions, given the global reach of higher education (HE) in recent decades and its impact on society, it is therefore essential that it is delivered in courses in a way that is consistent with both its core principles and the characteristics that define HE in an age of complexity.

In recent years, scholars in the field of education have been promoting different approaches to ecological transdisciplinarity to address the challenges presented by highly complex global issues related to climate change and sustainability [7, 8]. In his extensive work on the philosophy of HE, Barnett emphasises the need for universities to not only talk 'about life', but to also speak on behalf of life ('for life') and draw 'from life' itself [9, p. 16]. Barnett specifically advocates for a philosophy of HE that is 'realistic', 'critical', 'practical', and 'imaginative'. He suggests that this position places the field within the realm of social philosophy, and according to Barnett, this necessitates "the relationship between the field and social theory has to be porous: it has to allow for a transgression of boundaries" (Ibid.). What Barnett calls the "ecological situation" refers to the interconnection between entities of research, knowledge and their interactions with the world; indeed, "complexities are multiple and real" (ibid., p. 72) and HE must use all its resources to prepare researchers and students to navigate through the complexities and understand the challenges they pose. Among the benefits of a holistic approach to education there is an awareness of the complexity of the real world challenges students face. It helps stakeholders appreciate the complexity of educational challenges, avoiding simplistic solutions that might overlook the underlying systemic issues. Systems thinking encourages educators, administrators, and policymakers to view education as a complex system where various components (students, teachers, curriculum, policies, community, etc.) are interconnected (see [10] on the development of a connected curriculum). This perspective helps in recognizing how changes in one part of the system affect the others. From a student's perspective, introducing systems thinking in their learning process empowers them to analyse complex issues that will not

be adequately assessed if analysed in isolation. And, importantly, students learn to see their role within larger systems, fostering a sense of agency and responsibility in contributing to societal and environmental solutions. Indeed, they come to appreciate how in an interconnected environment not only have their actions and micro-behaviours an effect on current generations, but also on future generations.

Educational institutions are amongst the key stakeholders in the collaborative efforts needed to bring CE at scale [11]. Particularly, HE provision of CE learning is fundamental to equip the next generation of business leaders with the necessary skillset to drive circular innovation. Yet, while the academic literature on the CE has bloomed recently, the number of studies taking an education perspective with a focus on higher education institutions (HEIs), is scarce [12, 13]. Responding to the calls for research exploring innovative approaches to education for a CE [12], and the "development of a social–ecological approach to management education and scholarship (…) [which] recognizes the interdependence between environment, society, and business" [14, p. 207], this article proposes an innovative pedagogical approach to CE education that shows how to integrate it in HE and why this aligns with a HE that aims to be realistic, critical, practical and imaginative [9]. It does so by drawing on one of these authors' experience in incorporating CE learning in HE provision at the postgraduate level. Particularly, the context of this research is Cardiff University Business School (UK), whose strategy is 'to make a positive impact on the world'. This work falls within the remit of 'teaching responsible management', one of the categories through which the varieties of responsible management learning can be classified according to Cullen (2020) [15].

The remainder of this article is organised as it follows. Section 2 synthetises CE developments across different quarters, including the academic literature, showing that the systemic nature inherent in the CE coupled with its imaginative strength to step outside the current linear system makes it aligned with HE mission as seen in Barnett. It also places education for CE (ECE) within the context of education for sustainable development (ESD) highlighting commonalities between the two fields and sketching the status of this emerging research field at the intersection between CE and education. Subsequently, Section 3 delineates our pedagogical proposal of integrating CE learning in HE by indicating how CE learning has been incorporated in a postgraduate course drawing on the recently released i5 PRME Playbook, an open access resource specifically designed for transforming business education and developing more responsible leaders [16]. Finally, Section 4 highlights the research contributions as well as potential research areas that could be explored in subsequent studies.

Circular Economy and Education for the Circular Economy

The CE is considered as "the most celebrated sustainability idea of the past decade (…) [whose] salience is likely to endure in the coming decade" [17, p. 1247]. Embraced by several national and supranational institutions, for one the United Nations Environment Programme highlights that "circularity and sustainable consumption and production are essential to delivering on every multilateral agreement, from the Sustainable Development Goals to the Paris Agreement to the post- 2020 global biodiversity framework" [18, p. 1], and several businesses from across the globe [19], the CE is also a rapidly developing field of academic enquiry.

Scholars from across disciplines have contributed to the CE field. More specifically, business and management studies have concentrated on some key areas including circular business models, consumer's behaviour, digital technologies and supply chain management [20]. Nonetheless, while the transition towards the CE must be business led [21], it is surprising that the academic literature on ECE is just about emerging. In fact, as evidenced by Whalen et al. (2018) [22] while the ESD literature has been growing, only few studies have explored approaches to integrate CE thinking in current HE curricula. Yet, if the involvement of the business sector is crucial for the emergence of innovative circular solutions and to bring them to scale, more efforts should be devoted to understanding how CE learning can be effectively developed to train the next generation of responsible business leaders, given the reach of HE as a pivotal global stakeholder and its impact on future business leaders. As content within the ESD literature can be relevant for ECE [22], pertinent questions become: what is meant by ESD? What can be learnt from it that has relevance for ECE? Does ECE meet modern HE's needs to navigate the age of complexity? And, next, how can it be implemented effectively within the context of HEIs?

According to the United Nations Educational, Scientific and Cultural Organisation, "education for sustainable development (ESD) gives learners of all ages the knowledge, skills, values and agency to address interconnected global challenges including climate change, loss of biodiversity, unsustainable use of resources, and inequality. It empowers learners of all ages to make informed decisions and take individual and collective action to change society and care for the planet" [23, p.1]. HEIs are recognised as key player for promoting ESD [24]. In fact, it is argued that they should take leadership in transformational education [25] and that management education in HEIs is key to train the responsible leaders of tomorrow [26]. Amongst the UNESCO's key competencies for sustainability, systems thinking, "the ability to recognize and understand relationships, to analyse complex systems, to perceive the ways in which systems are embedded within different domains and different scales, and to deal with uncertainty" [27, p. 44], is recognised as a crucial competence for addressing sustainability related issues [28]. This is the case because given the complex, non-linearity and the boundary crossing nature of sustainability issues, the multifaceted cognitive abilities enabled by systems thinking are essential to address them. Put simply, to address any of the UN's SDGs, systems thinking is fundamental (ibid.). These arguments in the ESD literature mirror recent developments in the Principles for Responsible Management Education (PRME) literature where it is argued that "responsibility calls for leaders at all levels to possess more than technical knowledge of their business. It requires understanding their and their organization's interdependent relationships to the social and environmental systems that they are embedded in. They must skilfully navigate ambiguity and solve adaptive challenges within and across these systems" [16, p.11].

The CE stands as an ideal candidate to promote both the acquisition of systems thinking skills amongst students and responsible leadership. As pointed out by De Angelis (2022) [29], CE thinking is fundamentally aligned with systems thinking. In fact, CE thinking, at its core, prompts businesses to view themselves as part of the wider systems within which they operate: reintegration of economy within ecology and recognition that products in a CE are products that are designed considering their interaction with the natural environment throughout their lifecycle, underline CE thinking [30, 31]. Moreover, the CE is "not the only smart and green strategy there is, but probably the most sustainable business model improving simultaneously ecologic, social and economic factors" [32, p. 91]. Therefore,

CE learning enables the double outcomes of promoting responsible management leadership and of equipping students with key competencies that will empower them to face and solve complex societal grand challenges within the context of real businesses.

As shown in De Angelis & Ianulardo (2024) [33], the CE is characterised by an inherent systemic dimension and can be thought as an exercise in moral imagination by providing a cognitive and structured framework which represents an alternative to the limitations and moral failures of the current linear system. Here, it is worth highlighting that despite being two different conceptual schemes, systems thinking and moral imagination are strictly linked in that it is only by looking at the complexity of social reality and its interconnections that an alternative can be thought and applied. The systemic nature of CE can be grasped from Braungart & McDonough (2008)'s [34] comparison between nature's cyclical processes and the cradle-to-cradle vision which inspires the CE model: "The tree is not an isolated entity cut off from the systems around it: it is inextricably and productively engaged with them. This is a key difference between the growth of industrial systems as they now stand and the growth of nature" (p. 79). Indeed, in the CE model "waste equals food" (p. 92) means that the very concept of waste has no room in this conceptual framework. In fact, according to it, as nature leads to "more trees, more species, greater diversity, and more complex, resilient ecosystems" (p. 92), so a CE vision that takes its inspiration in the cradle-to-cradle model of natural ecosystems will lead to more complex and resilient industrial systems. The current industrial system has overlooked both biological and technical nutrients, leading to a linear economy that only partially addresses end-of-cycle waste without actively eliminating it. As Braungart & McDonough point out, biological nutrients benefit the biosphere, while technical nutrients support the technosphere, the industrial processes systems (p. 93). A student who is acquainted with the concept of the CE should consider the entire production process from its conception, taking into account the broader socio-ecosystem and the well-being of future generations. It is essential to ensure that products and services are integrated into a circular model that eliminates the concept of waste.

On the other hand, moral imagination is defined by Werhane (2008) [35] as the capacity to imagine new possibilities to tackle existing moral conflicts, overcoming the strictures imposed on one's existing mental model in specific circumstances. Following this characterisation of moral imagination as "the ability in particular circumstances to discover and evaluate possibilities not merely determined by that circumstance, or limited by its operative mental models" [36, p. 93] and "think creatively within the constraints of what is morally possible" [37, p. 34], the CE by challenging the short-sightedness and unilaterality of the current linear system and devising a cognitive framework that considers production and consumption processes in their entirety embodies a moral dimension. In fact, as shown in De Angelis & Ianulardo (2020) [38] the CE has been able to catalyse interest at the business, institutional and government level, providing technical and economic solutions to the problem of limited resources, and has designed solutions to prevent wasteful production process to take place. The introduction of innovative business models for CE, new technologies to make better use of renewable resource and more sustainable consumption processes can provide students with an indication of how systems thinking and imagination can help envision a more sustainable economic system.

These two dimensions, complexity and imagination, which recent scholarship (e.g., Barnett) has identified as the defining characteristics of HE and which we have seen as inherent to CE, involve multiple pedagogical activities and dimensions in order to be fully absorbed

by students. First of all, it is required a non-dogmatic approach to the current economic system that is able to question its main assumptions. Secondly, the multiple interactions and connections between disciplines, subjects and with the real world (business and society) must be grasped and investigated. Thirdly, imagination must be encouraged and promoted, provided that it is framed through credible cognitive frameworks (and the CE provides such a credible cognitive framework as shown in [38]). Only to the extent that the imagination is channelled through a cognitive process can the realised outcome be aligned with the envisioned imaginary. Therefore, we claim that for these reasons ECE is particularly in tune with the needs of modern HE, in particular with its "ecological situation" [9] requiring HE to be realistic, critical, practical and imaginative to navigate amid multiple complexities of modern societies.

How then is CE thinking taught in HEIs? Whalen et al. (2018) [22] describes CE learning using a serious game 'In the Loop'. Kopnina (2019) [39] discusses the use of case studies to highlight challenges in CE implementation. Kirchherr & Piscicelli (2019) [40] describe an undergraduate course designed to introduce students to the CE, characterised by five pedagogical principles, i.e., *interactivity*, *non-dogmatism*, *reciprocity*, *constructive alignment* and *problem-based learning*, and CE exercises which they refer to as *drill game*, *buzzword bingo*, *a teardown lab*, *an eco-industrial park simulation*, *policy instruments*, *circular party* and *circular futures*. In a very recent literature review concerning implementation of CE in HEIs, Vergani (2024) [41] finds that case studies and active learning approaches are the most commonly tools used in teaching followed by other approaches including site visits, games, workshops, flipped learning and challenge and problem-based learning. Yet, to the best of these authors' knowledge no other study has investigated CE learning through the pedagogical lenses of the i5 PRME Playbook, which is covered next.

Integrating Circular Economy Learning in Postgraduate Education Provision

This section illustrates how CE learning has been incorporated into the teaching of one of these authors and its pedagogical underpinnings. The teaching experience here reported refers to the postgraduate module 'Marketing in Context' within the MSc Marketing at Cardiff Business School (UK), taught in the academic year 2023/2024. For this course, one of these authors was the module leader and one of the module convenors. One of the key thematic areas taught in this module is sustainability marketing. Accordingly, students are introduced to the evolution of marketing into green and sustainability marketing. They learn about both marketers taking steps towards the development of more sustainable value propositions, and sustainable consumer's behaviour. This teaching provision responds to the much-welcomed inclusion of sustainability perspectives in marketing education to make it more relevant and meaningful [42]. In fact, as put by Kemper et al. (2022) [43], "failing to integrate societal issues into marketing education, will cause the discipline to become increasingly irrelevant" (p. 318). The CE is then proposed as a viable strategy for the achievement of sustainability marketing reflecting the recognised relevance of the CE to the sustainability agenda for marketers and scholars alike. For example, Mostaghel et al. (2023) [44] build on the 2017 American Marketing Association's definition of marketing to propose both a revised definition of marketing as "the activity, set of institutions, and

processes for creating, communicating, delivering, and exchanging offerings that have value for customers, clients, partners, and society at large with respect for the environment and individuals throughout the life cycle of the offering" (p. 5), and the addition of 'person' and 'planet' as variables of the marketing mix [45, 46] to reflect CE requirements. Besides, the World Federation of Advertisers and Kantar (2023) [47] argue that "the key to sustainable marketing lies in advocating for and adopting circular principles in every aspect of the discipline" (p. 4). In the module, the CE concept is taught from both a producer and consumer's perspective, which is another element of novelty in the literature on ECE, where mostly the focus is on the supply side at the expenses of consumers [12].

The guiding pedagogical framework used for developing learning resources is the i5 PRME Playbook [16]: "a scientifically grounded and accessible teaching resource that is highly recommended to anybody who wants to advance their pedagogical skillset while developing students into more responsible leaders" [48, p. 364]. This resource is specifically designed for transforming business education and developing more responsible leaders [16]. The i5 PRME Playbook lists some pedagogical approaches– which are referred to as the impactful five (i5)– for developing more responsible leaders. These are: *make learning meaningful* by developing learning experiences that emphasise students' knowledge and experiences; *foster joy and well-being* by creating learning experiences allowing students to engage with emotions like delight, pleasure, wonder and surprise; *develop supportive social interaction* by designing collaborative processes in which students can listen, communicate and negotiate with others from different cultures and perspectives; *facilitate active engagement* via allowing students to express themselves through physical 'hands-on' and 'minds-on' activities, and *design for iteration* by developing learning through which students can experiment, learn from mistakes and, consequently, making changes in thinking and actions. Of these five pedagogical approaches, one of these authors leveraged on the *develop supportive social interaction* and *facilitate active engagement*. The next subsections describe how these two approaches have been implemented.

Develop Supportive Social Interaction

One of the so-called 'signature moves', i.e., concrete steps that can be taken to implement the pedagogical approaches in the i5 Playbook, in relation to *develop supportive social interaction*, is *teaming*. *Teaming* consists of "organising group experiences that explicitly develop students critical communication and interpersonal skills" [16, p. 57]. In every lecture one of these authors delivered, *teaming* was always part of it. Particularly, and in relation to the CE-related session, once students were introduced to the key principles in CE thinking, its enabling building blocks and implications for marketers and consumers alike, they were divided into groups of six and given a case study of CE implementation to reflect upon as a group task. The groups were very diverse as the module cohort included students from across different countries. As part of their assignment, they were asked to identify the principles underlying the case's business model (circular business in the fashion industry) and how the case's operating model and marketing approach compared with those of the luxury fashion industry. The case was chosen to specifically highlight multiple elements of value creation in circular business models, including the social dimension, which is little investigated in ECE literature [12]. Once they were set into groups, they were given half an hour to discuss the assignment questions within the group and to come up with a short

PowerPoint presentation which they had to present to their module convenor to receive some feedback. This was a formative opportunity for them to listen and learn from each other, communicate with each other and finally negotiate a position on how best to respond to the group task. *Teaming* was also a key component of one of the module assessments, the e-poster, for which, working in pairs, students had to develop an electronic poster about the relationship between the CE and the *UN SDG 12: Responsible Consumption and Production*. This was a further opportunity for them to develop collaborative skills and integrate different perspectives skills, in addition to creativity skills. The i5 Playbook [16] makes it clear why it is so important to help students develop collaborative skills: "when facing complex and systemic challenges, effective problem-framing and solving hinges on collaborative processes that demand cross-cultural competencies (…). Developing supportive social interaction in classrooms can help develop responsible leadership competencies, such as collaborative engagement, deep listening, perspective-taking, empathetic communication, cross-cultural understanding, negotiation, conflict resolution and sustaining relationships" (p. 51–52).

Facilitate Active Engagement

To facilitate active engagement, one of the suggested 'signature moves' is *authenticating*, which is about "exposing students to real-world issues and engage them in experiences that are authentic to their current and future realities" [16, p. 70]. Accordingly, they were exposed to a range of circular examples from the business context. This is particularly pertinent in relation to the future they are likely to be confronted with. With *The World Economic Forum* predicting that "by as soon as 2030, if your business model isn't circular, you won't be competitive" [49, p.1], the uptake of circular principles in the business context is very likely to increase. To enhance the authenticity of their learning experience, one of these authors organised a field trip to the *RemakerSpace*, which provided a great opportunity to gain a real-world exposure to the CE and how it can be operationalised. The *RemakerSpace* is a Cardiff Business School and PARC Institute not-for-profit initiative working with a range of stakeholders (businesses, communities and education providers) to drive the CE in Wales and beyond. The centre works by raising consumers' awareness of the benefits of reuse, repair and remanufacturing, and providing businesses with the skills and the equipment needed to develop circular business opportunities from remanufacturing and repair [50]. The site visit included a tour of the facilities communities, businesses and educational providers have access to, including electrical repair kits, industrial sewing machines for extending the lifecycle of garments, virtual reality systems to visualise repair interventions and 3D printers for printing spare parts. They also had the opportunity to see how some of these equipment work (with an actual showcase of 3D printing by the technician in loco) and to ask questions. The importance of developing skills through active engagement is equally emphasised in the i5 Playbook, where it is argued that "today's business challenges leave little room for leaders to be inattentive, distracted or apathetic (…). Looking to the future, effective leadership will continue to call for high levels of active engagement in the physical and virtual worlds (…). Facilitating Active Engagement aims at developing competencies such as empowerment and efficacy, problem finding and framing, future visioning, complex and systems thinking, flexible and provisional thinking and action, and managing uncertainty, doubt, and ambiguity" [16, p. 68].

Conclusion

Through the innovative pedagogy characterising the 'Marketing in Context' module, students achieved the learning outcomes of knowledge, comprehension, application, analysis, synthesis, and evaluation in Bloom's taxonomy (1956) [51]. Turning more specifically to the field of ECE, the pedagogical approaches followed in this module align with studies welcoming innovative and active learning approaches as "they are proven to better fit the CE features of multi-disciplinary and critical and system thinking" [52, p. 4]. The development of cognitive, behavioural and personal skills, such as systems thinking, collaborative skills and active engagement attitude, are the immediate outcomes of the above-mentioned teaching innovations.

On the other hand, as we have seen in the discussion of contemporary educational scholarship, Barnett (2021) [9] has called for HE to be "ecological", in order to address the complexities of current global issues and challenges, and 'imaginative', in order to see the future with new eyes. Imagination is crucial in envisioning new possibilities that are not limited by the current context and require a different cognitive approach to overcome the limits of the existing system. Summarising what HE should aim at, Barnett says that "we should be critical of what we see but also imaginative as to the future, and our philosophical efforts should contain some sense of the way higher education is in the world *and* that it has *possibilities*. A shorthand might be a *critico-imaginative* and *ecological realism*" (p. 3). In this spirit, we believe that this renewed view of HE can enter into a fruitful dialogue with the CE, especially in light of the call for humanising management education that some scholars see as a task for business schools. This dialogue is still in its infancy, and we aim to initiate it by exploring how the CE can contribute to it. By unravelling the logic behind the current linear industrial production system and, subsequently, by reimagining the entire production process, CE thinking can be viewed as an exercise in moral imagination. It is precisely this moral openness, with its ability to imagine alternative scenarios, in an increasingly complex and interconnected way that is shown by the teaching of the CE. Indeed, it manifests itself both towards future generations and in its care for available resources, showing the more properly humanistic aspect of this theme. This ethical and social dimension makes it possible to show students in a direct way what a humanistic management education consists of.

As indicated by Awan et al. (2023) [53] the increasing adoption of CE models requires a deeper understanding of the role played by global stakeholders in governing CE practices. These authors define as operational global stakeholders "those who are able to develop activities linked with the circular economy to develop products and services to serve global and local customers" (ibid., p. 18). With the expansion and global reach of HE in recent decades, we think that educational institutions can be considered amongst the key operational global stakeholders in the collaborative efforts needed to bring CE at scale [11]. In response, this article explored innovative pedagogical approaches in ECE, drawing on the i5 PRME Playbook, whose integration in ECE has not been reported yet in the ECE literature to the best of these authors' knowledge. As a result, it responds to recent research welcoming innovative and active learning approaches to ECE [52] and the development of a socio-ecological approach to management education [14]. The CE has been presented as an ideal candidate for promoting both responsible leadership and the development of systems thinking skills, whose relevance within the context of addressing complex, societal grand challenges, is widely acknowledged within the ESD and the PRME literature. Over-

all, this research contributes to the literature at the intersection between education and the CE, which is just about emerging.

We believe that the pedagogical approaches in the i5 PRME Playbook– for which we have shown a possible application in this article– can be applied across a range of modules within the business and management disciplines to further ECE and can contribute to advance the literature on ECE. In this study, we have not provided an empirical investigation, but we have sought to show how ECE is in line with HE's need for critical and imaginative education, and what pedagogical approach is appropriate to integrate CE learning with a specific class-tested proposal. Future studies could report students' voices in relation to the adoption of innovative pedagogical approaches within HEIs. Moreover, only two of the five impactful measures in the i5 PRME Playbook have been experimented with and reported for this research. Therefore, future research could explore the use of other measures such as *making learning meaningful*, *foster joy and wellbeing* and *design for iteration* within the context of ECE, either from an educator or student's perspective. Another potential line of enquiry could be to examine the cumulative effects of a comprehensive implementation of the i5 measures on skills development.

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References

1. Schroeder P, Anggraeni K, Weber U (2019) The relevance of circular economy practices to the sustainable development goals. J Ind Ecol 23:77–95

2. EMF (Ellen MacArthur Foundation) (2015) *Towards a circular economy. Business rationale for an accelerated transition*. Retrieved March 2023 from https://www.ellenmacarthurfoundation.org/publications/towards-a-circular-economy-business-rationale-for-an-accelerated-transition. Accessed 20 July 2024
3. Lacy P, Rutqvist J (2015) Waste to wealth: the circular economy advantage. Palgrave Macmillan, NY
4. EMF (2024a) *Circular start-up index*. https://www.ellenmacarthurfoundation.org/resources/business/circular-startup-index. Accessed 20 July 2024
5. EMF (2024b) *Transforming business: the leading voices of the circular economy*. https://www.ellenmacarthurfoundation.org/resources/business/transforming-business. Accessed 20 July 2024
6. Hopkinson P, De Angelis R, Zils M (2020) Systemic Building blocks for creating and capturing value from circular economy. Resour Conserv Recycling 155:104672
7. Nicolescu B (2014) From modernity to Cosmodernity: science, culture and spirituality. State University of New York, Albany
8. Cilliers P, Nicolescu B (2012) Complexity and transdisciplinarity– Discontinuity, levels of reality and the hidden third. Futures 44:711–718
9. Barnett R (2021) The philosophy of higher education. A critical introduction. Routledge, London and New York
10. Fung D (2017) A connected curriculum for higher education. UCL Press, London
11. Marcona M, Sehnem S (2024) Heading towards sustainability: an exploration of circular economy teaching methodologies through games, online platforms, and digital innovations. Int J Manage Educ 22:100995
12. Renfors S-M (2024) Education for the circular economy in higher education: an overview of the current state. Int J Sustain High Educ 25:111–127
13. Serrano-Bedia A-M, Perez-Perez M (2022) Transition towards a circular economy: A review of the role of higher education as a key supporting stakeholder in web of science. Sustainable Prod Consum 31:82–96
14. Colombo L, Moser C, Muehfeld K (2024) Sowing the seeds of change: calling for a social–ecological approach to management learning and education. Acad Manage Learn Educ 23:207–213
15. Cullen J (2020) Varieties of responsible management learning: A review, typology and research agenda. J Bus Ethics 162:759–773
16. i5 PRME (Principles for Responsible Management Education) (2023) *i5 Playbook - Transforming Business Education with 5 Impactful Methods.* https://i5.unprme.org/resources/. Accessed 20 July 2024
17. Kirchherr J, Urbinati A, Hartley K (2023) Circular economy: A new research field? J Ind Ecol 27:1239–1251
18. UNEP (United Nations Environment Programme) (2024) *Circularity*. https://www.unep.org/circularity. Accessed 20 July 2024
19. EMF (2024c) *Our network*. https://www.ellenmacarthurfoundation.org/network/who-is-in-the-network. Accessed 20 July 2024
20. Ahmad F, Bask A, Laari S, Robinson C (2023) Business management perspectives on the circular economy: present state and future directions. Technol Forecast Soc Chang 187:122182
21. Webster K (2013) What might we say about a circular economy? Some temptations to avoid if possible. World Futures 69:542–554
22. Whalen KA, Berlin C, Ekberg J, Barletta I, Hammersberg P (2018) All they do is win': lessons learned from use of a serious game for circular economy education. Resour Conserv Recycling 135:335–345
23. United Nations Educational, Scientific and Cultural Organisation (UNESCO) (2024) *What you need to know about education for sustainable development*. https://www.unesco.org/en/sustainable-development/education/need-know?hub=72522. Accessed 20 July 2024
24. Vargas-Merino J, Rios-Lama C, Panez-Bendezú M (2024) Critical implications of education for sustainable development in HEIs - A systematic review through the lens of the business science literature. Int J Manage Educ 22:100904
25. de Assumpção M, Monzoni N (2020) State-of-the-art practices being reported by the PRME champions group: A reference to advance education for sustainable development. Int J Manage Educ 18:100369
26. Ambrósio Avelar A, da Silva-Oliveira K, da Silva Pereira R (2019) Education for advancing the implementation of the sustainable development goals: A systematic approach. Int J Manage Educ 17:100322
27. Rieckman M (2018) Learning to transform the world: key competencies in education for sustainable development. In Leicht, A., Heiss, J. & Byun, W.J. (eds.) (2018). *Issues and trends in education for sustainable development* (pp. 39–60). UNESCO Publishing
28. Deets S, Rodgers V, Erzurumlu S, Nersessian D (2020) Systems thinking as a tool for teaching undergraduate business students humanistic management. Humanistic Manage J 5:177–197
29. De Angelis R (2022) Circular economy business models: A repertoire of theoretical relationships and a research agenda. Circular Econ Sustain 2:433–446

30. EMF, McKinsey, & SUN (2015) *Growth within: A circular economy vision for a competitive Europe*. https://www.ellenmacarthurfoundation.org/publications. Accessed 20 July 2024
31. Heinrich S, Jamsin E, EMF (2021) &. *What is complexity? An introduction for educators*. https://www.ellenmacarthurfoundation.org/resources/learn/higher-education-resources. Accessed 20 July 2024
32. Stahel W (2019) The circular economy. A user's guide. Routledge, Taylor & Francis Group, London & New York
33. De Angelis R, Ianulardo G (2024) Circular economy principles as a basis for a sustainability management theory: A systems thinking and moral imagination approach. Bus Strategy Environ 33:4861–4870
34. Braungart M, McDonough W (2008) Cradle-to-cradle design. Remaking the way we make things. Vintage Books, London
35. Werhane PH (2008) Mental models, moral imagination and system thinking in the age of globalization. J Bus Ethics 78:463–474
36. Werhane PH (1999) Moral imagination and management decision-making. Oxford University Press, New York
37. Werhane PH (2002) Moral imagination and systems thinking. J Bus Ethics 38:33–42
38. De Angelis R, Ianulardo G (2020) Circular economy as fictional expectation to overcome societal addictions. Where do we stand? Philos Manage 19:133–153
39. Kopnina H (2019) Green-washing or best case practices? Using circular economy and cradle to cradle case studies in business education. J Clean Prod 219:613–621
40. Kirchherr J, Piscicelli L (2019) Towards an education for the circular economy (ECE): five teaching principles and a case study. Resour Conserv Recycl 150:104406
41. Vergani F (2024) Higher education institutions as a microcosm of the circular economy. J Clean Prod 435:140592
42. Watson F, Stanton J, Beninger S, Domegan C, Reppel A, Shapiro S (2022) Teaching what society needs: hacking an introductory marketing course with sustainability and macromarketing. J Mark Educ 44:375–389
43. Kemper JA, Moscato EM, &Kennedy A-M (2022) Hacking the marketing education system: using macromarketing and the circular economy to make a better world. J Mark Educ 44:311–321
44. Mostaghel R, Oghazi P, Lisboa A (2023) The transformative impact of the circular economy on marketing theory. Technol Forecast Soc Chang 195:122780
45. Booms BH, Bitner MJ (1981) Marketing strategies and organisation structures for service firms. In: Donnelly JH, George WR (eds) Marketing of services. AMA, Chicago, IL, pp 47–52
46. McCarthy J (1960) Basic marketing. Irwin, Homewood, IL
47. World Federation of Advertisers (WFA) & Kantar (2023) *Sustainable marketing 2030*. https://wfanet.org/leadership/planet-pledge/sustainability-2030/about. Accessed 20 July 2024
48. Waldner C, Rasche A (2024) i5 playbook: transforming business education with 5 impactful methods, by principles for responsible management education. Acad Manage Learn Educ 23:363–365
49. World Economic Forum (WEF) (2023) *8 ways the circular economy will transform how business is done.* https://www.weforum.org/agenda/2023/03/8-ways-the-circular-economy-outperforms-traditional-business-models/. Accessed 20 July 2024
50. RemakerSpace (2024) *About us*. https://www.cardiff.ac.uk/remakerspace/about-us. Accessed 20 July 2024
51. Bloom BS, Engelhart MD, Furst EJ, Hill WH, Krathwohl DR (1956) Taxonomy of educational objectives: the classification of educational goals. Cognitive domain, Handbook I
52. Giannoccaro I, Ceccarelli G, Fraccascia L (2021) Features of the higher education for the circular economy: the case of Italy. Sustainability 13:11338
53. Awan U, Braathen P, Awan AM (2023) Navigating global stakeholder challenges: typology approach to circular economy management. Int Soc Prof Innov Manage ISPIM:1–27. https://www.proquest.com/openview/16d00a246f926e7acdbae9a39f23851b/1?cbl=1796422&pq-origsite=gscholar. Accessed 25 Mar 2025