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Teaching circular economy: Discussing limitations and opportunities of teaching about sustainable production

Abstract: One of the essential drivers of sustainable change for the circular economy is natural resource scarcity. The key development in the area of sustainable production and consumption that seeks to limit or even, ideally, stop continuous extraction of natural resources, is the cradle-to-cradle (C2C) framework. The C2C framework is based on the book Cradle to Cradle by Michael Braungart and William McDonough first published in 2002. The circular economy also poses threats to conventional business and production as in its ideal form, circular production should not mean churning out even more supposedly 'circular', 'sustainable', or 'green' products but fully re-using materials. The products need to be made not only to last but to have, at least ideally, all reusable parts. This is no easy task. Overt optimism of some of the circular economy promoters, such as The Ellen MacArthur Foundation, needs to be tempered with realism and realization for the potential for greenwashing. Even more problematically, the concept of the circular economy is intended to align sustainability with economic growth – just as an equally problematic concept of sustainable development (and the associated education for sustainable development or ESD) does. While the European Union states that the circular economy will "foster sustainable economic growth", critical scholars have noted that without radical degrowth in the economy (and population) circular economy is nothing but a new word for greenwashing. This paper will discuss how to teach students to think critically and pragmatically about the challenges and opportunities of the circular economy.

Keywords: circular economy; economic growth; education for sustainable development; environmental sustainability; greenwashing

Introduction: closed-loop production

Aside from the realization that environmental and social values are not found solely in economic terms one of the most essential drivers of change for the circular economy is natural resource scarcity. As the current system of 'cradle to grave' production, cheap consumer goods that are designed *not* to last – the concept known as 'planned' or 'built-in' obsolescence (Bulow 1986). Since producers are interested in consumers constantly buying their products, built-in obsolescence makes it economically unattractive to repair or reuse products. Simultaneously, many consumables are sold in potentially durable packages, while consumption item itself can be consumed in one gulp or bite. Many packaging materials could potentially last for hundreds of years and yet most of it is directly disposed of (Davis and Song 2006). The current industrial system erodes the biological and cultural diversity. Even eco-efficient industrial systems, while outwardly 'green', also lack in ambition as they typically signify a marginal reduction in the use of limited natural resources, rather than the complete

elimination of resource-depleting production (Washington 2015). Such systems may appear 'green' but they allow the industry to 'finish off everything, quietly, persistently, and completely' (Braungart and McDonough 2009: 62; 65). The electric cars might still consume electricity generated by using fossil fuels, which will stretch into the future without switching to true renewables such as sun and wind. 'Waste to energy' electricity, for example, which is touted as sustainable, destroys mixed materials (Braungart 2013).

The key development in the area of sustainable production and consumption that seeks to limit or even, ideally, stop extraction of natural resources, is the cradle-to-cradle (C2C) framework, based on the book *Cradle to Cradle: Remaking the Way We Make Things* (Braungart and McDonough 2002). C2C is based on the ideas of 'self-replenishing economy' (Stahel 1984), industrial ecology (Frosch and Gallopoulos 1989), ecological economics (Costanza 1992), regenerative economy (Geissdoerfer et al 2017), ecological management (Blomsma & Brennan 2017; Blok 2018).

Table 1 Overview of frameworks
Source: adapted from Tennant and Brennan (2015) and Kopnina and Blewitt (2018)

Thinkers	Concepts/Frameworks	Level of Application	Seminal Work by Year
Robert Ayres & Allen Kneese	Industrial Metabolism – understanding material and energy flows at the national level and within urban areas.	Industrial System	Ayres and Kneese (1969)
Barry Commoner	Ecological principles used to structure national economy	National	Commoner (1971)
Walter Stahel	Circular or loop economy through product life-extension.	Product Design	Stahel (1984)
Robert Frosch & Nicholas Gallopoulous	Industrial ecosystem	Industrial System	Frosch and Gallopoulos (1989)
Paul Hawken	Circular economy, restorative economy	Community	Hawken (1993)
John T. Lyle	Regenerative Design	National, industrial	Lyle (1996)
Thomas Graedel	Earth system ecology - biological systems and industrial systems influence each other.	Industrial System	Graedel (1996)
Janine Benyus	Biomimicry Design Framework based on looking at form, function, and processes in natural systems.	Product Design	Benyus (1997)
Gunter Pauli	Coined the term "upcycling". Developed the concept of the Blue Economy in a report for the Club of Rome.	Enterprise Development	Pauli (1998) Pauli (2010)

Michael Braungart & William McDonough	Cradle to Cradle (C2C) Design Framework.	Product Design	McDonough and Braungart (2002)

Critical approaches and revisions (greenwashing, business-as-usual)	Critical theory	General application	Rammelt and Crisp (2014) Haydn Washington (2015) Helen Kopnina (2017, 2018, 2019a and 2019b)

C2C seeks to create innovative production systems, rather than solely seeking profit by "digging up or cutting down natural resources and then burying or burning them" (Braungart and McDonough 2002:18). Critical scholarship in the fields of sustainable business and production is deeply skeptical of production that takes 'profit' as the only 'bottom line' (Kopnina and Blewitt 2018). Like C2C, circular economy (CE) aims to decouple economic growth from demand for natural resources. C2C is also closely related to biomimicry (Benyus 1997), and the blue economy (Pauli 2010).

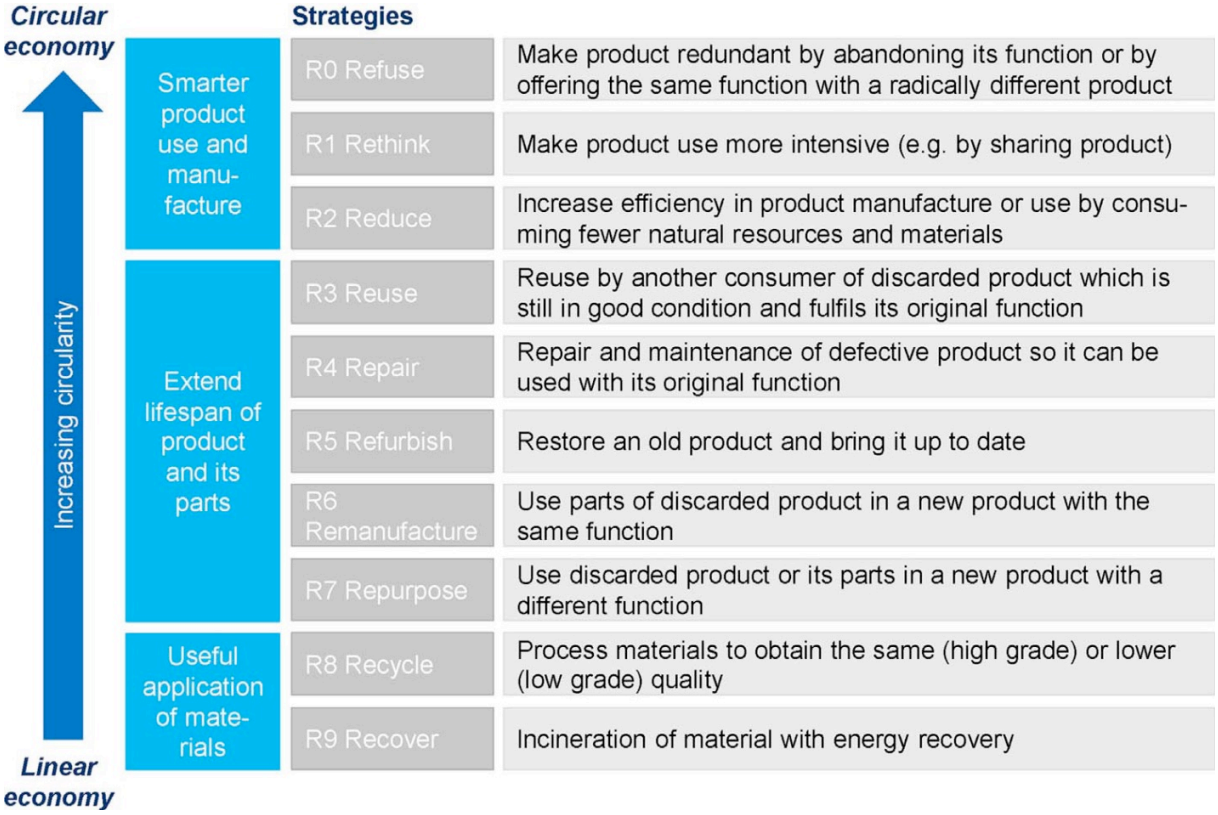
There are several fundamental problems with the typical cradle-to-grave production system and associated management styles, as discussed by the authors of the C2C framework. Already in the nineteen sixties in the essay *The Economics of the Coming Spaceship Earth* (1966), Kenneth Boulding, a British economist, compares the 'cowboy' and the 'spaceman' economies. The first is characterized by the notion of limitless resources, with consumption and production seen as 'progress'. By contrast to this the cowboy economy, a 'spaceman economy' sees the Earth is a single spaceship, with limits for both what can be taken from it in terms of natural resources and what can be disposed of (pollution, garbage). In a more modern interpretation, this signifies the "economy of enough" (O'Neill 2012). As Boulding states, "man must find his place in a cyclical ecological system which is capable of continuous reproduction of material form even though it cannot escape having inputs of energy" (P. 4). In the spaceman economy throughput needs to be limited (Boulding 1966:5).

Instead of recreating these patterns of unsustainable production, the C2C system is intended to be beneficial to the environment. This ambition fits within the larger discussion of ethical issues associated with production processes that not only are profitable but also socially ethical and environmentally sustainable (Attfield 2015; Blok 2018). The application of this the deep ecology in business operations requires radical transformation and recognition of what is intrinsically valuable, including nonhuman nature – and not just the instrumental "natural resources" (Klikauer 2014; Attfield 2015). Practically, this implies the need to recognize that nonhuman species should be allowed to share space with human inhabitants in urban or rural environments, not just in 'nature'

where people can be seen as ‘guests’, but also recognizing that to be truly ‘part of nature' humans need to adopt an ethics of conviviality (Van Dooren and Rose 2012). In green urban planning, buildings will contain plant and moss-covered roves and walls providing habitats or housing opportunities’ (such as nests) to other species as well (e.g. Oberndorfer et al 2007). Circular systems promise a radical departure from ‘less bad' to ‘all good’ (Genovese et al 2015).

Circular economy challenges

Consider the priority table below:



We note here that a lot of practices that are currently branded as “circular” are in practice quite far from the ultimate goal, infinite reuse. One of the challenges of a circular economy is indeed what to do with most consumables, such as food and clothes. Can any food items, for example, really be "circular" once consumed – without addressing waste that ends up in the toilet? Simply, having eight billion omnivores on this earth can hardly be sustainable, as food or clothes are made of material elements, biomass, that once digested or warn for many years, degrade or become “downcycled”. The overt optimism of some of the circular economy promoters such as The Ellen MacArthur Foundation needs to be tempered with the realization of the potential for greenwashing. If strict assessment criteria are applied to some of the “best practice” examples, starting with Coca Cola, which reduces rather than eliminates a small proportion of its plastic packaging, it cannot be seen as “best practice” (Kopnina 2018; 2019a). The ‘hall of fame’ of supposedly “circular” companies often engage in eco-

efficiency and downcycling, using their stated intention to transit to the 'circular economy' as a way of justifying the retention of unsustainable patterns of production. The companies often focus on merely *minimizing* damage without the needed overhaul of the entire business model.

The circular promoters seem to overestimate the potential to close cycles of 'technical nutrients' given an expanding human population and the rise of high consumption is aspiring middle classes (Rammelt and Crisp 2004; Washington 2015; Kopnina 2019b). The shift to 'biological nutrients' to substitute for 'technological nutrients' may necessitate enormous monoculture plantations that will compete with crops and wilderness (Kopnina and Blewitt 2018).

While the circular economy or C2C may be most effective in the context of "degrowth" (O'Neill 2012) or radical limitations in the high level of consumption (Isenhour 2010; Rees 2010; Holt 2012), unfortunately, this goes against the grain of dominant economic thinking (Washington 2015). Without a strict certification system as with C2C, some companies that position themselves as "best practice" only grab the 'low hanging fruit'. While "buying less" is already challenging for most consumers, stopping shopping as a practice altogether is not what Western consumer culture encourages (Isenhour 2010: 460), and much of the subverted 'circular economy' may support the 'expansionist myth' (Rees 2010:5).

Optimistic and realistic scenarios

What is significant to remember about circular frameworks is that the critique of the current system of production, including the supposedly progressive sustainable efforts to promote recycling and eco-efficiency reaches far deeper than much of the conventional sustainability literature. The critique of recycling as actually downcycling, or eco-efficiency as an effort to make a bad system last longer are not easy to sell to mercantile-minded companies or the optimistic consumers. Yet, positive examples of simple C2C or circular products are not that hard to find in 'pre-industrial' designs, as demonstrated by the milkmen distributing refillable and washable milk bottles, or clay pots as containers. Instead of making new products, re-use can also offer a simple and cheap way of cycling resources. Some forms of innovative materials and production technologies, especially the ones supporting biomimicry (Benyus 1997), the blue economy (Pauli 2010) can certainly help as well. Still, the challenges of making some items such as food and clothing truly "circular" remain.

Reflection and conclusion: Teaching a circular economy

Considering the above, we can draw some conclusions as to how to teach students to think critically and pragmatically about the challenges and opportunities of the circular economy. First, the framework, with all its complexity and various definitions, needs to be discussed with students in such a way so that complexity is not lost while the core concepts (such as 9R hierarchy) and actions

(such as production methods that adhere to "closed-loop" principles) are made central. The students also need to be made aware of a larger social and political context that has a danger to subvert the practice of circular economy to business as usual scenarios. These scenarios emerge from the political and economic status quo that privileges economic growth and free markets that often resist government regulation of ecologically harmful or socially unjust processes and products.

Particularly fitting to this task is the employment of critical pedagogy and/or ecopedagogy. Originating in Marxist perspective, and based on the work of Paulo Freire (1972), critical pedagogy is a teaching approach inspired by critical theory, which attempts to help students question and challenge posited "domination" of capitalist, corporate, or political structures, and to challenge the broadly shared assumptions and practices that underline this domination (Kahn 2010). Having in part evolved from critical pedagogy, ecopedagogy is less ideologically leftist and more environment-centered (Nocella 2007). Remaining socially critical, ecopedagogy supports the position that learning about environmentalism prepares students to recognize the types of ethics that are seldom taught at school - deep ecology and ecocentrism (Sitka-Sage et al 2017), and inclusive multispecies pluralism (Kopnina & Cherniak 2016). Assuming that conventional environmental education and particularly education for sustainable development is still influenced by the anthropocentric economic thinking (Bonnett 2007; Kopnina, 2012, 2014; Sitka-Sage et al 2017), critical pedagogy scholars point out that "industries and the state have strong institutional and monetary biases" against justice for the environment (Nocella 2007: 3). In contrast to conventional education, critical pedagogy outlines an "approach to fight and unveil the complex and interwoven lies of the global capitalist machine" (Ibid). While it must be noted that critical pedagogy is informed by "green Marxism", its critical stance is not limited to socialist, communist or leftist politics. One can argue that the forceful removal of resources from the rich to redistribute to the poor – as in the noble aspirations of the Russian revolution – aside from bloody consequences, the total global economic pie stays the same, thus neo-Marxist slogan for 'equitable distribution' is not going to avoid adding billions to the class of global over-consumers. In education, this, therefore, does not imply that the students will be taught some "leftist ideology', as a neoliberal critique of progressive education sometimes states, but encourages critical thinking beyond the conventional greenwashing discourse of circular economy.

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