Critical Questions for Sustainability Research in Computational Creativity

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Abstract

Sustainability in and through digital technology has up until very recently been framed in modernist terms, focused on quantification and optimization of resource use. This framing has been frequently criticized for being limited in scope and impact, and has been framed as *shallow sustainability* in environmental ethics literature. Sustainability within computational creativity (CC) research is an emerging topic. To avoid the pitfalls of shallow sustainability, we conceptualise and propose a *'deep sustainability'* perspective in computational creativity research. This enables a relational approach to the predicament of the climate crisis by critically examining the values and assumptions that underpin CC research. Building on this, we reflect on and discuss what deep sustainability would mean for the future of sustainability research within the CC community, and raise critical questions with the particular aim of sparking discussions around *how sustainability research is and ought to be approached* within the community.

Introduction

While the design, development, and use of computational creativity (CC) technologies are increasing rapidly, the climate crisis continues to put pressure on ecologies and people. Increasing emissions are pushing us towards a scenario in which the Earth becomes an uninhabitable hot house (Steffen et al., 2018). Despite this, there has until recently been very little regard for and interest in researching sustainability within the computational creativity community. While there are a handful of examples from the last four years that have initiated reflections on the topic of sustainability (e.g. Pease and Pease, 2023; Utz and DiPaola, 2023; Ren et al., 2023; Chang and Ackerman, 2020), it can be argued that computational creativity research in sustainability is in a very early stage.

Sustainability research is broadly concerned with addressing environmental and social questions that relate to sustainability. One of the common criticisms of sustainability research concerns the framing within which such research is performed (Braidotti and Bignall, 2018; West et al., 2021). Sustainability is often conceptualized in modernist terms, which reduces the complex problems of sustainability to the evaluation of carbon emissions, or energy consumption (e.g. Gasparatos, El-Haram, and Horner, 2008; Lacoste et al., 2019; Ligozat et al., 2021). However, pressing arguments have been raised as to why this perspective is limited. First, sustainability is reduced to a very narrow 'thing' that can be measured, which does not reflect the complexity of the issue(s). This limited framing has been argued by several scholars as one of the reasons why the sustainability of technology research has failed to address sustainability concerns *in practice* (e.g. Brough et al., 2020; West et al., 2021), overlooking the social and contextual dimensions that are central to the change toward sustainability. Furthermore, it has been argued to disregard the larger factors, such as potential rebound effects (Hilty, 2012), societal and cultural factors (Brynjarsdottir et al., 2012; Strengers, 2014), multi-species perspectives (Alaimo, 2012), generational factors (Åsberg, 2021), and ethical dimensions of sustainability (Olausson, 2024).

In environmental ethics, this modernist approach to sustainability has been often described as *shallow sustainability* (Olausson, 2024). Another central critique from West et al. (2021) has highlighted how sustainability science in general needs to shift towards relational thinking, shifting away from modern ways of 'slicing' the sustainability phenomena, and addressing it in the context of our relations in the world. This relational thinking follows and builds on critiques from (Haraway, 1987) about occupying the 'god-eye' perspective in performing research[1]. Considering these timely critiques from sustainability research and environmental ethics, it is important to reflect on how sustainability research at CC looks like today, and to raise discussions on *"How should it look like in the future?"*.

In this position paper, we review literature from sustainability research and environmental ethics that can help us to consider sustainability in new and radically different ways. We particularly bring forth *deep sustainability* as a perspective that enables us to tackling the wicked nature of the multiple crises we are facing today. This term is based on the notion of deep ecology (Olausson, 2024) - a concept that suggests a relational view of the world and considers difficult, multi-dimensional environmental issues, but does not

[1]Haraway regards objectivity and notions of universal truth as the "god trick", as they rely on an assumption that we can see everything from nowhere. Haraway, instead, emphasizes that our knowledge and perspectives are always situated and we are bound to these in-situs as embodied beings.

obscure the complexities of socio-cultural change. Following this, we reflect on how the considerations coming from deep sustainability can help us approach and guide sustainability research within the CC community in an ethically grounded direction that frames the sustainability concerns in their full complexity. We aim for this position paper to particularly *provoke and spark critical discussion within the CC community about the future of sustainability research in CC*.

Current State of Sustainability in Computational Creativity Research

Research within CC[2] has traditionally focused on the development of "computational creativity agents" and creativity support tools (CSTs). Key texts that have informed and directed CC research over the years include Margaret Boden's work on creativity (Acy and Rice, 2023; Boden, 1993), as well as Colton and Wiggins (Colton and Wiggins, 2012) paper arguing that fully intelligent autonomous creativity agents would be the final frontier to which the CC community should strive for. Additionally, there efforts for evaluating computational creativity are prevalent, such as work by Jordanous (2016). Despite the increasing attention paid to climate change and sustainability globally, sustainability concerns of CC research have not been part of this research agenda until very recently.

In 2020, Chang and Ackerman presented a paper on educational agents for sustainability education among school-aged children (Chang and Ackerman, 2020) at the ICCC conference, addressing sustainability for the first time within the community. With that as a starting point, the CC community has engaged with the topic of sustainability through a panel conversation at ICCC 2022, which urged researchers to address questions of sustainability (ICCC, 2022). Subsequently, three papers were published in 2023 that took on this challenge and explicitly focused on environmental sustainability (Pease and Pease, 2023; Utz and DiPaola, 2023; Ren et al., 2023). The most outspoken of these three, written by Pease and Pease (2023), argues that the CC community should prioritize matters of sustainability and that they, as a research community, are central stakeholders in addressing such concerns and have an ethical obligation to do so. In many ways, it is a direct call to action for the research community. A second paper from 2023 (Utz and DiPaola, 2023) presents results from research aimed at estimating and quantifying emissions that could result from Generative AI. This paper explicitly compares the estimated computational cost of Generative AI with that of the total consumption of entire countries, such as Mauritania and Kenya. Lastly, Ren et al. (2023) explore the design space of Generative AI systems that inform users about the expected power consumption of such systems by pre-estimating the resulting carbon emissions.

[2]While we acknowledge that there is a lot of CC research conducted outside of the ICCC conference, in this paper, we explicitly discuss the CC research that is conducted within ICCC, the largest conference on computational creativity.

Sustainability Research and its Contemporary Critiques

Sustainability has often been conceptualized as a reductive concept both in science and public discourse – focused on reducing this wicked and complex phenomenon into a set of simple and manageable metrics. These metrics often focus on measuring first-order effects (Hilty, 2012) from direct resource use, such as CO2 emissions or kWh of energy consumed, which can later be used to engineer solutions. Decreased consumption of resources is undoubtedly beneficial, but the modernist focus on metrics and efficiency gains disregards the wider consequences that come with reducing sustainability to these aspects alone. These considerations include for example the rebound effect and how indirect effects (Hilty, 2012) further from direct use of technology can have unanticipated consequences. For instance, efficiency gains in computer energy use may lead to increased, not decreased overall energy consumption (Hilty, 2012).

As explained by Hilty and Aebischer (2015), the 1st order effects refer to the direct effects that come from production, use, and disposal of the technology. The 2nd order effects refer to 'effects of the use', such as optimization and substitution of tasks, and induction and obsolescence effects. The 3rd order considers systemic effects, such as emerging risks and the rebound effect, in which technology ends up being used *more than less* as a result of optimized resource consumption.

Additionally, a modernist framing of sustainability ignores the extractivist paradigm causing environmental harm in the first place (Braidotti and Bignall, 2018) and makes the assumption that measuring and providing this information to people will, by default, lead to behavioural change. This assumption has been strongly criticized for its limitations, as it disregards the complexity of everyday life and society at large (Brynjarsdottir et al., 2012; Strengers, 2014) and obscures the cultural and social dimensions of change (Alaimo, 2012). Likewise, research within environmental psychology has shown that having access to correct information is often not sufficient to drive behavioural change or to bridge the knowledge-action gap (Kollmuss and Agyeman, 2002). Instead, for example, significant changes in our values, culture, and relation to our environment may be required. This topic relates to how we *intrinsically* or *extrinsically* value ecologies and non-humans, and urges questioning these relations and values on a fundamental level (Olausson, 2024).

To further problematize the modern lens on sustainability, it is strongly anthropocentric, often disregarding non-human perspectives altogether (Braidotti and Bignall, 2018; Åsberg, 2021). This results in the (re-)creation of undesirable knowledge, power, and socio-material configurations, particularly between humans and non-humans.

A major challenge for sustainability of CC, as we see it, re-examine these prior critiques of sustainability research and to avoid the same pitfalls, when the sustainability research agenda gains more ground in the CC community.

An Alternative Perspective: Deep Sustainability

Acknowledging the problems of the modernist shallow framing of sustainability, there is clearly a need to take on a relational (and arguably more nuanced) approach toward sustainability. In the literature we can find different uses of such perspectives, for example, through the use of the terms "strong" and "weak" sustainability to describe different approaches to behavior change (Newell, Twena, and Daley, 2021) and descriptions of wider philosophical orientations to sustainability that are based on shallow and deep ecology thinking (Olausson, 2024; Naess, 2005), as well as the relational sustainability science (West et al., 2021). Drawing on these concepts and uses of the term, we present *deep sustainability* and its implications across several dimensions.

As argued by several scholars (Braidotti and Bignall, 2018; Åsberg, 2021; Fredengren and Åsberg, 2020; West et al., 2021; Olausson, 2024), more realistically framed, sustainability is a multifaceted phenomena that requires fundamental change in how we relate to ecologies and non-humans, in terms of values and culture. For example, sustainability has been described as intra- and intergenerational, stretching over past, present and future (Fredengren and Åsberg, 2020). This temporal relation is often left out, resulting in short-sightedness. Instead, several sustainability researchers argue that there should be a consideration of the future of the planet and all beings living on it when acting today in order not to compromise their future (United Nations, 1987).

Furthermore, we argue that we should aim to understand the past to situate our practices in their historical contexts. In practice, it would mean bringing such temporal considerations into the design and research processes of CC systems. In sustainability research, this has for example been approached using methods that explicitly focus on past and future, such as "counterfactual artifacts" and "design futuring" to understand how past decisions have influenced the current state of sustainability, or how current actions could impact the future state of sustainability (Eriksson and Pargman, 2018). Applied to CC technology, similar questions could be raised regarding the past and future of CC technologies. This expanded focus on temporality is one central aspect of deep sustainability.

A second dimension that we would like to highlight entails the recognition of various locations of bodies and their entangled relations, which enable us to address the complex causalities that relate to sustainability (Haraway, 2016). As a concrete example, it is problematic to focus on one geographic context and exclude the impacts in other parts of causal processes. Acknowledging the chemicals produced in the manufacturing of computational hardware in developing countries could serve as an example of these entanglements. However, things become even more complex when we combine place with temporality that was discussed earlier: what if those chemicals have implications for the plants or humans living many generations later in the location of the manufacturing plant? Thus, complex temporal-spatial causalities are central to deep sustainability, and these considerations should somehow be addressed in the case of CC technology as well. These two dimensions relate closely to and support the concept of relational sustainability thinking (West et al., 2021).

Furthermore, deep sustainability orients the focus toward deeply transformational rather than incremental and shallow change, shifting away from efficiency gains towards questioning the underlying paradigm and exploring ways to deviate and break free from it. Several sustainability scholars have argued for this transformational change (e.g. Knowles, Bates, and Håkansson, 2018; Newell, Twena, and Daley, 2021), simply because incremental changes are not enough to address the destruction of our ecologies and environment. These deep transformations also coincide with changes in values and relating to the world.

Reflection on Deep Sustainability and CC Sustainability Research

While there is currently a limited number of publications on sustainability at ICCC (4 papers), we here draw upon this body of work and reflect on the implications of adopting a deep sustainability perspective. In particular, we have examined how sustainability is conceptualized in these examples and what questions arise from our reading of these publications through the lens of deep sustainability that could guide future efforts to broaden the research agenda on sustainability in CC.

Taking explicit stances on sustainability and calling for reflexive work to identify such sustainability stances

The first insight came forth from the observation that many of the current research papers that analyzed environmental sustainability were taking implicit, rather than explicit stances on sustainability. One way of taking an explicit stance could be to include a reflection on the environmental sustainability of the performed research or technologies in CC papers, and with regards to papers that explicitly address sustainability in CC, some critical positionality statement could be included on what kind of view the authors take on sustainability. Furthermore, this would be a question to address also on the level of the research community through on-going discussions and dialogue. Therefore, the primary purpose of this paper is to give birth to such conversations.

Secondly, in order to enable and facilitate such discussions on matters of sustainability in a broad sense, in terms of the research that is undertaken at CC, there would be a need to develop reflexivity and support for researchers in understanding and critically analyzing environmental sustainability. We hope that some of the perspectives that we have provided in this critical paper are contributing to development of these insights by providing a broad perspective of contemporary technology sustainability research and its problems and pitfalls.

Need for prioritizing critical questions

Although CC sustainability research is in a very early state, we highlight that this is a critical time to set the agenda and to discuss *how* such research should be done in the future. Consequently, we argue that there is a need to focus on critical questions that have come forth in broader sustainability research. If we want the CC community to address questions of sustainability in an effective way, without wasting plenty of time trailing the same paths that have been previously tread in wider technology sustainability research, we should learn from those remarks and continue building on these takeaways.

Some of the particularly difficult questions that always surface regarding technology is the question of when is it OK to develop technology, and when should we withhold and restrain from doing so in order not to aggravate environmental crises (e.g. Baumer and Silberman, 2011). These questions are important to address and could prevent excessive reliance on technological solutionism, while also facilitating critical stances in sustainability research. There is a need to engage critically with the root causes of the ecological crisis, rather than the effects. For example, while providing information and reductionist solutions may be useful at times, research would benefit from targeting the long-term change in values and culture. Although this could sometimes be achieved through providing information and designing reductionist interactions, these approaches can also easily misconceptualize the sustainability problems and become unhelpful in transitions towards sustainability, borderlining practices of "greenwashing" in design of technology and interactions. In the best scenario, these critical questions can help the research community develop toward a self-critical and introspective direction, when it comes to sustainability.

Further critical questions for the future of sustainability research in CC We argued above that there is a need to engage in a discussion about the critical questions in regard to sustainability of CC research. While not comprehensive, we raise a few questions that could be part of this agenda:

- Futures and afterlives of technologies developed in the community: how can we ensure that developed technologies will not aggravate the environmental crisis and lead to increased use on various levels (2nd, 3rd order effects and future generations)?
- How has the history of knowledge and science-making in the CC community influenced its approach to sustainability research? Why has sustainability research entered the community so late? And how can we ensure that it stays on the research agenda?
- What epistemological commitments are actively being taken in CC research today, when it comes to sustainability?
- What stakeholders (human and non-human) get to matter in CC research?

This list is by no means exhaustive, but these are few questions that can guide the way. The first consideration is the impact of the technologies *beyond the community* in the future and on various levels of socio-technical transformation, with an opportunity to reflect on potential future implications of developing the CC systems, including how they might be put to use in the society and whether they have potential effects beyond the immediate 1st order effects. This also encourages researchers to critically reflect on their responsibility in pushing out certain technologies, especially those that have a high capacity to change society. A relevant example from general technology research is that many AI pioneers have recently regretted inventing certain technologies due to their negative environmental and societal impact. While such questions might have not been relevant until now, they are important to consider. Second, reflecting on how the knowledge-making practices and science-making paradigm in the CC community has shaped and is currently shaping the way (sustainability research) is conceptualized can be generative to future research. Why has sustainability research entered the agenda fairly late and can we learn something from this for the future of the research community? Why are certain ways of approaching sustainability more prevalent than others? Additionally, we urge the community to reflect on which stakeholders get to matter in CC research. While there is a lot of consideration put into themes such as co-creativity autonomous agents, there is also a need to consider other non-humans (environment, animals, etc.) and the potential impact that CC technologies and CC research might have on them.

Practical changes in the research community, such as including a section in research papers that describes the potential sustainability impact of the conducted research, is a desirable progression in order to bring visibility to questions of sustainability. However, these concerns ideally need to be taken into account already when conducting the research. For directions on how to do so, we can draw on research within human-computer interaction, where there are multiple examples of alternative ways of designing technology with sustainability in mind. For instance, in a paper by Liu, Bardzell, and Bardzell (2018), permaculture philosophy was applied to design processes in order to prioritize notions of nature, while Mann et al. (2018) explores the concept of regenerative computing, in which "better" does not necessarily mean more technological advancement, but rather recovery, transition, transformation and regeneration. Further examples include solar-powered web servers Abbing (2021) and designing the concept of longevity into hardware and software Jang et al. (2017). These various examples are challenging the current values in design of technology – and can serve as examples of what kind of work would be desirable to see more of in the ICCC in coming years as well.

Conclusion

In this paper, we have introduced a set of literature from contemporary sustainability research, and argued for the need to take a well informed and broad perspective on sustainability research to effectively respond to the climate crises. We have reflected on the current state of sustainability research at ICCC, and raised critical questions regarding it. We urge the CC community to take stock of the sustainability literature noted above going forward, and to engage in further critical discussions around how sustainability research should be done in the CC community in the future.

Author Contributions

First author initiated this paper, and both authors participated in conceptualizing and writing the paper.

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