

Walking at the Margins of the Anthropocene: A Novel Curriculum to Enhance Sustainability Learning and Teaching

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Abstract

We explored the walking pedagogy presented on six occasions to various disciplines to ground and contextualize abstract concepts surrounding the Anthropocene to enhance student learning in the broad area of sustainability. In this process, we facilitated the translation of wicked global problems of sustainability into tangible issues within a local context in order to root participants with an explicit sense of place and facilitate a potentially transformative experience. The United Nations Sustainable Development Goals (SDGs) served as a useful heuristic for critical exploration of connections between individual participants and their surrounding environment. The complexity and interconnectedness of the SDGs were discussed with participants in the context of local water quality, biodiversity, land use practices, innovation, urban renewal, and cultural issues.

Emergence of Anthropocene Studies

United Nations 2030 Agenda¹ offers a globally accepted framework for sustainable development with the potential to blunt adverse effects of the hypothesized Anthropocene with regards to the anticipated negative impacts on human civilization and natural ecosystems. The Anthropocene has been proposed as a new epoch in geological time where human activity has become the dominant force shaping land, atmosphere, oceans, and other biogeochemical processes along with associated biota known collectively as the biosphere². The Anthropocene would supersede the Holocene epoch where relatively stable climatic and environmental conditions over the past ~12,000 years allowed humanity to flourish, yet there is also evidence for periods of instability within the Holocene that required human adaptation with regards to food security³.

In theory, geological evidence of the Anthropocene will eventually become evident in the stratigraphy (i.e., a chrono-sequence of fossil and other material occurring in rock strata) on a planetary scale and specifically the fossil record associated with the relatively sharp transition into this hypothesized new epoch. The Anthropocene Working Group within the International Commission on Stratigraphy concluded the Anthropocene should be treated as a “formal chrono-stratigraphic unit and one of the stratigraphic signals around the mid-twentieth century of the Common Era⁴”; however, a consensus has yet to be reached across the geological sciences and is contingent upon irrefutable stratigraphic evidence⁵. Work continues to find the *golden spike* or signature in the stratigraphy representing the advent of this new geological epoch although several candidates are under consideration which rely on markers such as radionuclides, organic matter, or plastics⁶.

The Anthropocene as a concept migrated quickly across many disciplines, most notably into the Social Sciences which accounts for a quarter of literature references (2002 to 2022) as determined using the Scopus⁷ database and is then followed by the disciplinary groupings of Environmental Sciences and the Arts & Humanities. However, Earth and Planetary Sciences only account for 10% of the total (Table 1). The rapid proliferation of Anthropocene related research across a diverse array of disciplines appears to have created ideal conditions for transdisciplinary study. In turn, the Anthropocene has taken on broader meaning as we consider the consequences of current anthropogenic impacts on current social systems, networks, and institutions, and the environment and living organisms which collectively function as natural ecosystems, while the Anthropocene as a concept is challenging human temporal cognition and anticipatory thinking⁸⁻¹⁵.

Scopus 'Subject Area'	Percent of Publications
Social Sciences	24.7%
Environmental Science	19.2%
Arts and Humanities	15.7%
Agricultural and Biological Sciences	10.3%
Earth and Planetary Sciences	10.0%
Engineering	3.0%
Business, Management and Accounting	2.5%
Economics, Econometrics and Finance	2.2%
Medicine	1.9%
Other Disciplines Clusters (17)	10.5%

Table 1: Elsevier Scopus database search for "Anthropocene" as found within title, abstract or keywords (2001-2022) which yielded a total of 9,726 references. Geological Sciences would fall within the Earth and Planetary Sciences subject area.

As Anthropocene studies further evolve, the inherent complexity of subject matter will likely benefit from transcending disciplinary silos, already evident within the sustainability literature¹⁶. Such transdisciplinary collaboration in relation to complex systems was also articulated in the 2030 Agenda which calls for all sectors of society to work together for solutions and that the "Sustainable Development Goals and targets, including the means of implementation are universal, indivisible and interlinked" in sections 52 and 71, respectively¹. We assert that the direct cause and effect relationships between most SDG Targets cannot be ignored, and inherent complexity should be embraced.

The pedagogical approach presented in this paper occurs at the intersection of sociology, ecology, and geology, and casts a curricular lens on socio-ecological transitions necessary to achieve the aspirations of the 2030 Agenda¹ while attempting to remain congruent with the conceptual framework for the Anthropocene that originated within the geological sciences. The non-conventional pedagogy of walking has the potential to enhance experiential student learning in relation to the surrounding local environment

whether it be natural or human built^{17,18}. Walking pedagogies have also been used effectively across the domains of teaching, learning and research¹⁹. The walking pedagogy can also be regarded as a deeply traditional approach as the Greek philosopher Socrates is thought to have walked the streets of Athens in convivial engagement which appears to have played a role in the founding of his philosophical schools²⁰.

Pedagogical Approach

University College Cork (UCC) is located adjacent the Cork City Centre yet the campus and nearby Mardyke Walk (Fig. 1) are among the relatively few patches of continuous tree canopy within the urban core. The UCC campus also functions as an arboretum for curricular and co-curricular engagement, and the campus is regarded as a living laboratory for experimentation with and upscaling of sustainability solutions²¹. The juxtaposition of highly urbanized and 'green' spaces provided an ideal environment for exploring and developing a walking pedagogy focused on socio-ecological factors driving or inhibiting a *just transition* toward sustainable development and decarbonisation.

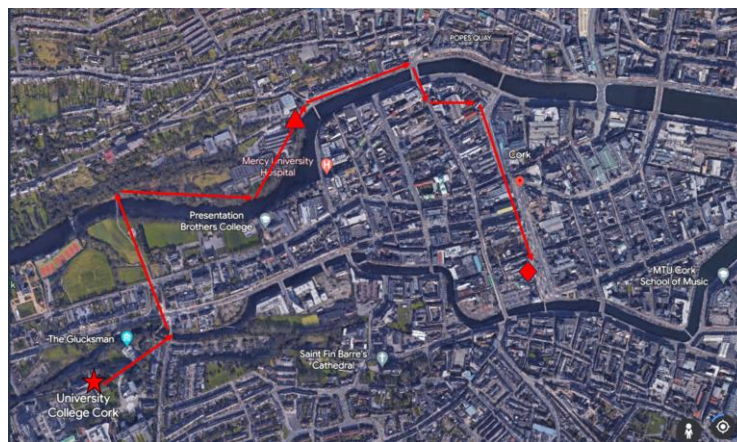


Figure 1: Satellite image of Cork City with the UCC Main Campus denoted by a red star at the lower left. The red arrows indicate the overall direction of the walking route which varies depending on time, learning objectives, and participant agility. Intervention point at the midpoint was a distinct intersection of urban green, blue, and grey infrastructures (red diamond) where the River Lee first appears channelised. The terminus at the Robo-Trees near Cork City's Main Library (red diamond). <https://earth.google.com/web/>

Our walking pedagogy was aligned with previously published methodologies within the same regional context of southwest Ireland^{12,22,23}. Students and academic staff were presented with stories, metaphors and symbols that draw attention to portals, liminal spaces, bridges, and transition zones to conceptualize a potential planetary state change as evidenced by phenomena such as climate instability, elevated rates of biodiversity loss, and mass human migration. We moved through a variety of temporal scales such as geologic eras, periods, and epochs to expand participant's understanding of geological timescales. This process was enhanced by identifying local features such as fossils and landscape geomorphology to create a living laboratory for participant inquiry while also guiding them to challenge their own basic assumptions of sustainability in practice. An on-campus collection of medieval Ogham stones also served as a visceral connection to a collective ancestry while also serving as a useful metaphor for stratigraphy patterns

occurring in rock layers.

Participants were given opportunity and space for both guided and unguided critical discourse with peers as we walked between intervention points. Additionally, participants were challenged to ponder and imagine the potential for localisation of sustainable practices. At the midpoint, they were guided through a walking mindfulness exercise to increase their awareness of surrounding flora and fauna along a wooded river walk before emerging into highly developed urban space. Within the city centre, we exposed and explored issues such as dereliction, flood control walls, urban agriculture, and “Robo-Trees”, i.e., a technology-based alternative to living trees.

This walking curriculum developed around central themes which are:

- Knowing their campus and its sustainability mission
- Considering geological timeframes and stratigraphy
- History of the local landscape and changes to underlying geomorphology, terraforming, altering of water flow, loss of marsh wetlands
- Identify natural spaces and connecting to the surround nature/ecosystem
- Reimagining the urbanised city centre

Depending on the participants and the academic requirements of their programme, students were asked to reflect upon their experiences, or to incorporate their understanding into assignments or assessments. Participant safety was a fundamental concern, so group size was limited to 25 individuals and a risk assessment was conducted *a priori*. Care was taken at road crossings and participants were advised to keep hydrated, wear comfortable clothing, and apply sunscreen. We were also sensitive to accessibility issues in the design of walking routes and to potentially triggering stimuli such as urban noise.

Walking Through Time and Space

A total of 6 unique guided walks were conducted for undergraduate and postgraduate students, academic and administrative staff, and a foreign delegation from the National University of Colombia. Participants were from a diverse array of disciplines which included sociology, engineering, business, law, ecology, and education. One such group was the 5-nation TESTEd ERASMUS+ project²⁴ aiming to create an open-source European Syllabus on Education for Sustainable Development for teacher training programmes.

Walks typically lasted 2-hours in duration but given the bespoke nature of our offering, we accumulated approximately 4-hours of material which consists of over 35 discrete intervention points based on 6 themes previously stated. A representative sample of intervention points are presented below which includes primary SDG connection points.

Thematic Area

UCC and its sustainability mission



Examples of Intervention Points

- The walk begins at the gates of the Honan Chapel adjacent the UCC campus as our first metaphor of transitions. Displayed at the gate is the UCC Motto “Where Finbarr Taught, Let Munster Learn.” Saint Finbarr is thought to have founded a monastery which founded Cork. Participants were oriented to metaphorical terms, e.g., marginal or liminal spaces.
- The Quad is surrounded by the oldest buildings of UCC and is the administrative core. Here is found the first Green Flag in the world awarded to a university by the Foundation for Environmental Education. This was a student-led initiative which provided a moment to honour this milestone in youth activism²¹ (Fig. 2A).
- The Quad is divided into four quarters and represents the 4 colleges of UCC. It is also a symbol for transdisciplinarity when viewed as a unified whole and the transcendence of disciplines as needed to solve global sustainability challenges.

Geological time scales and stratigraphy



- The 2 tallest trees at UCC and surrounding area are ~175-year-old Giant Sequoia (*Sequoiadendron giganteum*) with a potential life span over 2,000 years, i.e., ~70 human generations which begin expansion of participant’s temporal capacity (Fig. 2B).
- Ogham Stones collection (~1500-years old) exhibits a written language carved onto these standing stones and is a tangible metaphor for fossils and stratigraphy as these carved marks were left in stone by previous human generations.
- The limen stone at entrance to the West Lodge has a well-preserved ammonite fossil in limestone, once seafloor sediment. Ammonites were lost to extinction ~66 million years ago when $\frac{3}{4}$ of all plant and animal species were extinguished from the fossil record⁵. The concept of stratigraphy was discussed with geologic timescales.

Historical and current land use practices



- Mardyke Foot Bridge over the River Lee marks the furthest extent of a once highly productive estuarine ecosystem. The upstream source of the River Lee at Gougane Barra was formed by glaciers at the end of the Pleistocene epoch (~12,000 years ago), is Ireland's first National Park and is a contested space with proposed wind turbines.

- Transition point from a relatively natural meandering river with vegetated riverbanks to a channelised river with enduring stone quay walls from the historical seaport (Fig. 1 and 2C). Participants reflected on the thousand-year legacy of impactful human development at this intervention point of stark contrast and transition. At this point, participants often appear to grasp the concept that humanity is becoming the dominant force shaping planetary processes.

- Castle Street in the city centre, site of the historical Water Gate of the Anglo-Norman walled city founded in the 11th century. Canals were dug to drain marsh wetlands which were later covered over but water still flows beneath through a series of culverts. Medieval walls were eventually breached, and few remnants of this old wall remain. The medieval wall now serves as a metaphor for a proposed network of flood control walls.

Connecting with green spaces



- Wildflower meadow for pollinators and biodiversity along the River Lee on the UCC Campus as an example of an ecological restoration project.

- The Mardyke River Walk provided an opportunity for a mindfulness exercise where participants can connect with a natural ecosystem by walking in silence and listening to the sounds of the wind rustling leaves or birdsong. After ~5-minutes, we shared the story of Rachael Carson and *Silent Spring*²⁵ about the detrimental effects of agrochemical on bird populations.

- Invasive species of Japanese Knotweed (*Fallopia japonica*) occurs along the Mardyke River Walk. Humanity has moved plants and animals globally with increasing frequency since the Age of Discovery began five centuries ago. Introduced species can have devastating consequences to local ecosystems.

Reimagining urbanisation



- Distillery Fields, a post-industrial landscape adjacent the Mardyke River Walk and is the old site of Cork Distilleries Company. This site has become a contested space as UCC wants to redevelop the old bottling plant building for the Tyndall National Institute, a deep-tech research centre specialising in both electronic and photonic innovation.

- A new urban agriculture enterprise called Cork Rooftop Farm which uses permaculture practices on repurposed local roof tops. This intervention opens a conversation on sustainable agriculture and reducing the carbon cost associated with modern food systems.

- Robot Trees or CyborgTree in the City Centre at a cost of €350,000 and are promoted as a green solution. The design intended to draw air from street level with fans and pass it over a bed of moss acting as a filter, but the design's effectiveness is uncertain²⁶.



Figure 2: (A) UCC Quad area where principles of sustainability were discussed in the context of a living laboratory and SDG 4. Note the Foundation for Environmental Education Green Flag flying alongside the Intersex Inclusive Pride Flag, discussed in context of SDG 10. Photo credit: Jessica Mcevoy; (B) Giant Sequoia trees adjacent the UCC Boole Library were discussed in the context of ecological timeframes spanning multiple human generations. Photo

credit: Briony Supple; (C) Transition from a relatively natural meandering river to a channelised river as demarcated by the gateway into the Mardyke River Walk. Photo credit: John Barimo.

Pathways Into the Anthropocene

The contemporary crises of climate and biodiversity loss can trigger anxiety and even trauma within those contemplating or working on issues associated with the Anthropocene²⁷. However, hope and action appear to relieve the cognitive and physical burden for those afflicted²⁸. We took great care in our walking pedagogy to provide a hopeful point-of-view and examples of tangible local or global actions that impacted positive change. Participants were also provided opportunities to share their creative ideas and/or proposed actions or solutions.

We developed this curriculum on the Anthropocene primarily to address the necessity for hope and action that can provide a sense of agency for participants. We aimed to contribute to their development of anticipatory, normative, critical, and systems thinking competencies²⁹ in the context of local environment and community. In the process, participants were offered inroads into and a context for life-long, life-wide, and life-deep learning^{30,31} and pathways to become engaged citizens within their communities with insights into the global implications of collective action or inaction. The walking classroom also provided a powerful metaphor for life's journey as we traversed and embodied dimensions of time and space with convivial intent.

Our walking classroom attempted to confront the complexity of unsustainable practices and negative impacts of human technology and development on the biosphere which also aligns with the transformative sustainability learning (TSL) framework³². TSL showcases the Head, Heart and Hands model of holistic development as distilled from the Cognitive, Affective and Psychomotor domains of Bloom's Taxonomy³³. We would argue that the Head or knowledge acquisition has generally been the main locus of curricular focus within higher education. Higher and further education curricula do include the Hands or skills development as an apparent secondary locus, e.g., teaching laboratories or design studios. However, the Heart or Affective domain often appears forgotten or even avoided. The Heart can provide the motivation or impetus for change, yet caution must be taken not to attempt indoctrination of participants but provide them the safe space to contemplate their values based on their own experiences and reflections.

TSL offers a compelling framework, but the Transformative Learning Theory component of TSL often appears overlooked³⁴. Our walking curriculum is congruent with the stepwise framework of Jack Mezirow^{35,36} with an aim to provide ample relational opportunities for embodied transformative learning experiences. We would assert that the *disorienting dilemma* generally occurred when students were confronted with the current accelerated species extinction rates on a planetary scale compared with the mass extinction event 66 million years ago at the end of the Mesozoic era⁵. The fossilised ammonite relic appeared to offer a tangible touchstone for the Anthropocene's significance on evolutionary and geological timescales.

While participants were guided through a sequence of intervention points, they were subtly challenged to reflect upon their own assumptions, beliefs, and values in relation to personal practices or overarching systemic constructs. Care was taken to reaffirm that there are no foregone conclusions regarding the Anthropocene and that we collectively

stand at the threshold of this hypothesised geological epoch with a multiplicity of possible pathways moving forward¹⁷. The 2030 Agenda¹ offers a viable trajectory towards the sustainability of human civilization not necessarily in conflict with naturally occurring ecosystems. Subsequently, the walking mindfulness practice provided a moment for reflection while silently ambling through dappled green light filtered by the tree canopy before flowing into the inspirational story of Rachael Carson's *Silent Spring*²⁵. Carson's work led to the banning of detrimental petrochemicals such as DDT (dichloro-diphenyl-trichloroethane) while arguably inspiring the birth of the modern environmental movement. Time between intervention stations also provided ample opportunity for reflective discourse amongst participants as they tended to cluster in groups of 2 or 3.

We draw from a pool of resources including preparatory information on SDGs and the Anthropocene, an array of potential interventions, with an optional solution oriented post-walk workshop to create bespoke experiences specific to desired learning outcomes. When this walking classroom is integrated into a module or learning-unit, there is increased scope for participants to discuss their experience through the lens of personal action. However, we do realise the need for quantitative and qualitative data to assess the transformative nature of this curriculum in terms of modifying short and long-term student perceptions and behaviours.

Environmental and ecological processes were negatively impacted by dominant human cultures and many technologies in the wake of World War II², now known as the Great Acceleration. While there are an array of pathways for societal (re)connection with natural ecosystem processes³⁷, it can be argued that the 2030 Agenda¹ offers a transdisciplinary language and globally agreed upon roadmap to sustainable development with the SDGs targets and indicators. The 2030 Agenda can also serve as a teaching and learning heuristic and onramp into the larger questions of an equitable pathway in the journey towards sustainability. However, we assert the importance of critical thinking in relation to all frameworks and models. We also recognise that discussions of the 2030 Agenda should incorporate subsequent global agreements such as the Paris Agreement on Climate Change³⁸ and Kunming-Montreal Global Biodiversity Framework³⁹. The understandings of traditional indigenous peoples, wisdom traditions, and alternative frameworks such as Buen Vivir can provide valuable insights thereby creating braided pathways towards a comprehensive sustainability that would *Leave No One Behind*^{67,40}. Similarly, we honour that evoking the ancient traditions and ancestral memories of Ireland such as walking, teaching and storytelling can provide potent opportunities for publicly performed culture-in-action rooted in the present moment while attempting to *remember the future*^{17,23}.

Acknowledgements

Our sincere thanks to Maggie O'Neill for her initial encouragement and review of the manuscript. Also, to Edmond Byrne, Maria Kirrane, Kieran Keohane, Colin Sage, Catherine O'Mahony, Cliona Maher, Briony Supple, J.P. Quinn, José Ismael Peña Reyes, Hernán Gustavo Cortés Mora, María Alejandra Guzmán, and Sophie Ingenillen for their participation and feedback during the evolution of this project.

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