Transforming Knowledge and Research for Just and Sustainable Futures

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Abstract

The paper considers what it means to transform knowledge and research for just and sustainable futures. The paper begins by outlining how we can conceive of knowledge and research in light of Mbembe's recent call for a 'new planetary consciousness' and principles of epistemic justice. It is argued that just and sustainable futures require challenging existing knowledge hegemonies and hierarchies linked to the colonial legacy and embracing a pluriverse of knowledge systems and languages. In part two, the paper explores what it would mean to transform knowledge, research and education by creating new ecologies of knowledge and an expanded conception of the knowledge commons. Transforming research involves embracing transdisciplinarity and knowledge co-creation while transforming education involves efforts to decolonise and decarbonise education systems. The third part of the paper provides concrete examples of research to demonstrate the opportunities and challenges in implementing transdisciplinary approaches. The paper concludes by reflecting on the role of UNESCO in supporting the transformation of knowledge, research and education. Here, it is essential to consider the political economy of knowledge production that provides a context for transformative change. UNESCO's attention, it is suggested, ought to focus on expanding knowledge commons, strengthening support for international collaboration in transdisciplinary research and advocating for a view of inclusive and good quality education that is consistent with a new planetary consciousness.

Introduction

In his keynote presentation to the 30th Anniversary conference of the UNESCO Chairs programme, the Cameroonian critical theorist Achille Mbembe made a compelling case for transforming knowledge and research as a basis for realising more just and sustainable futures. According to Mbembe, addressing the challenges of the 21st Century, including climate change, inequality, the threats posed by global pandemics such as COVID-19 and the opportunities and risks associated with the rise of new technologies, requires the development of a new planetary consciousness. By this, he means a way of thinking that recognises the interconnectedness of all living things and the need to protect the planet for future generations. This new consciousness would require a shift away from the current focus on individualism and competition towards a more collective and cooperative approach. It requires the development of a new kind of intelligence that is more holistic and interconnected and that must emerge from paying attention to three sets of relationships, namely, our relationships with nature, with technology and with each other. Underpinning each must be an ethics of care based on a recognition of our 'all-worldness' as human beings. According to Mbembe, 'Living together on the same planet means …learning to take care of it; learning to repair it and, above all, to share it. Care, repair and sharing are… the very conditions of its sustainability and ours' (Mbembe, 2023: : 6).

Crucially for Mbembe, developing such a consciousness requires breaking with Western-centric models of development and instead drawing on all of the 'archives of the world'. This means moving away from a Western-centric view of knowledge and instead embracing diverse knowledge systems, including IK systems that have been neglected and marginalised through colonialism. Mbembe identifies traditional African knowledge systems built on the principle of *ubuntu* (the interconnectedness of all people and all living things), in particular, as having an important role to play.

Challenging existing knowledge hierarchies and hegemonies and embracing epistemic pluralism as a means for developing a new kind of education appropriate for the 21st Century also lies at the heart of UNESCO thinking. The report of the International Commission on the Futures of Education (UNESCO, 2021) calls for cooperation and solidarity to strengthen 'planetary consciousness', complex ecologies of knowledge, acknowledging the necessity of drawing upon the diversity of knowledge systems and sources (p. 126-127). This conception of a multiplicity of knowledge advocates for the inclusion of ideas and thoughts that celebrate a greater diversity of possible futures beyond the present' (p. 126) and legitimises 'diverse sources of knowledge to the exigencies of the present and future' (p. 126).

However, while seeking to draw on diverse knowledge systems as a basis for realising more just and sustainable futures is a necessary and noble aspiration, it raises fundamental questions about how we conceive of knowledge and research. For example, how do we practically integrate dominant, often Western, understandings of science and the disciplines as they are taught in education systems worldwide with non-Western and traditional knowledge systems? It also raises fundamental questions about the way that we generate knowledge through research. How can we make research more relevant to the needs of disadvantaged communities struggling with the challenges of unsustainable development? How can we meaningfully co-create new knowledge between researchers, communities, policymakers and practitioners to develop genuine ownership of the findings and draw on the knowledge and expertise brought by different participants? How can we make the findings of research more accessible to the wider public? What are the implications for formal education institutions as well as for funders of research and the publishing industry? Finally, what role is UNESCO currently playing, and what role should it play in such a process of knowledge democratisation, given its historic mandate to promote science, culture and education for the good of humanity and the planet?

In seeking to answer these questions, the first part of the paper will aim to set out a compelling rationale for transforming knowledge and research for just and sustainable futures. Here, the focus is on the idea of epistemic justice, which, it is argued, provides a necessary basis for realising social, economic and environmental justice as well as for tackling the complex, 'wicked' problems of unsustainable development. The paper will then consider some key areas on which a research programme on rethinking knowledge and research might focus. It will be suggested that these include promoting transdisciplinary research based on principles of knowledge co-creation and equitable partnership working. As will be argued in section three of the paper, reorienting knowledge and research in the way implied above requires fundamental changes to the wider knowledge ecosystem that can only be realised through

increased international collaboration and cooperation in the research process. Here, it will be suggested UNESCO has a crucial role to play.

It is important from the outset to be clear about what is meant by 'just and sustainable futures' in the context of this paper. The concept of 'just transitions' provides a useful starting point, a way of conceiving how and in whose interests transitions to sustainable futures might be realised. Swilling (2020: 7) defines a just transition as:

'a process of increasingly radical incremental changes that accumulate over time in the actually emergent transformed world envisaged by the SDGs and sustainability. The outcome is a state of well-being founded on greater environmental sustainability and social justice (including the eradication of poverty). These changes arise from a vast multiplicity of struggles, each with their own context-specific temporal and spatial dimensions.'

The idea of just transitions is fundamentally concerned with redressing intersecting inequalities, including those based on class, caste, gender, rurality and disability, whilst simultaneously protecting the natural environment and other species as a basis for just and sustainable futures. Although the current paper is focused principally on issues of epistemic justice, it will be argued that the quest for epistemic justice is intricately linked to social, economic, and environmental justice and to the idea of just transitions. This is because struggles over just and sustainable futures inevitably draw attention to the role of different kinds of knowledge in perpetuating and overcoming inequalities and that communities' control and ownership of knowledge are essential if they are to be empowered in leading the transformation process[1].

Section One: What does it mean to transform knowledge and research?
In this section, the aim is to set out the case for why knowledge and research need to be transformed if we are to achieve just and sustainable futures. Before proceeding further, however, it is important to clarify what we mean by knowledge and research.

What do we mean by 'knowledge and 'research'?
What is understood by knowledge and research is culturally embedded and context-specific. At the most general level, and for the purposes of this paper, however, 'knowledge' concerns our understanding as human beings of the natural and social worlds. It can take many forms (abstract, practical, experiential, emotional, spiritual, etc.) and is expressed in diverse ways (from abstract theorising to forms of social interaction to artistic expression). It is the basis on

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[1] In developing this paper and in light of the issues involved, it is important to be transparent about the position of the author. The paper's topic goes to the heart of my work as UNESCO Chair on Transforming Knowledge and Research for Just and Sustainable Futures. My interest in this topic has developed over many years through engagement as an educator, researcher and activist with efforts to make education more relevant for communities facing the challenges of poverty, inequality and environmental risks, including climate change in Africa and in other low and middle-income contexts. My thinking has also been shaped by my involvement in efforts to decolonise education over many years. Nonetheless, I write from a position of relative privilege as an academic based in an elite Northern university. As such, I recognise that there is much that I can learn from scholars and activists who are at the sharp end of dealing with the challenges of transforming knowledge and research elsewhere. This paper is, therefore, best conceived as a contribution to an ongoing debate.

which we make sense of our world, our relationships with each other, the natural world, and inanimate objects such as technology. Knowledge is thus deeply culturally embedded and fundamentally social in nature. We learn from each other through our interactions with nature and technology, pass information down through generations, and build collective understanding through communication and collaboration.

'Research', on the other hand, refers to the processes through which we generate knowledge about the world. These processes are also culturally embedded. They might include activities ranging from conducting scientific experiments in a laboratory to forms of experiential learning in informal settings. Research, like knowledge, is fundamentally social. Discoveries and innovations arise through collaborative thinking and action. Within the Western tradition, innovation has historically been linked with the achievements of great individuals (who are typically White males). The reality, however, is that research inevitably draws and builds on existing knowledge and on the insights of others (even where this is not acknowledged)[2]. The social and collaborative nature of knowledge and research gives rise to the knowledge commons, i.e. the view that knowledge and research are fundamentally a public rather than a private good. That is to say that knowledge and research should be publicly accessible and democratically governed. More recently, the idea of the digital commons has been coined to extend this idea to knowledge and research that is held digitally.

At a societal level, knowledge and research are situated within 'knowledge systems'. These include the people, institutions, technologies and strategies involved in producing, circulating, utilising and governing knowledge. Languages are integral to knowledge systems as it is through language that knowledge systems may be accessed. Knowledge systems play a crucial role in fostering innovation, learning, and decision-making. Within modern societies, domains such as science, engineering, medicine, law and education rely on formal knowledge systems that shape how knowledge is produced, circulated, implemented and governed. These are often organised in the form of disciplinary knowledge. However, knowledge systems also operate informally and describe the networks through which social learning occurs within communities. Informal knowledge systems might encompass a range of concerns, from sharing knowledge about agricultural practices and food and water management to local knowledge that is shared on WhatsApp groups. Knowledge systems may also be traditional in nature, as is often the case with Indigenous medicine or initiation ceremonies.

Knowledge systems may operate at different scales, from the local to the global. Formal knowledge systems typically operate at national and global levels. Research increasingly involves forms of international collaboration, and the means by which knowledge is disseminated through books, journals, and online resources are increasingly global in scope. Community based and non-governmental organisations also increasingly share knowledge within localised, national and global networks. Whereas traditional knowledge systems are often associated with specific localities, they also increasingly take on a global dimension. Chinese medicine, for instance, is an example of a traditional knowledge system accessible in many parts of the world outside of China. Traditional knowledge is also increasingly diffused through the development of diaspora and, in some instances, is accessible through the internet.

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[2] As the physicist Isaac Newton famously put it, he stood on the shoulders of giants in making his discoveries.

Knowledge systems shape and are shaped by the wider social and cultural contexts in which they are embedded. What counts as valuable knowledge or research is also context-specific. In many traditional societies, for example, what counts as valuable knowledge or research is linked to a broader belief system that starts from a view of the fundamental interconnectedness of people and all living and inanimate objects. On the other hand, modern science is often based on a rationalist belief in the abstract and universal nature of knowledge and research. Indeed, as Mbembe has argued, the 'history of modernity … coincides with the story of the progressive separation of humans from their environment … Science has played a critical role in this process …' (Mbembe, 2001: 63).

Knowledge systems also change over time. This might be in light of new discoveries and ideas that challenge existing understanding. For example, the philosopher of science, Thomas Kuhn, discusses how modern science has evolved through various paradigm shifts as new facts give rise to new theories of science. A classic example was the shift from Newtonian to quantum mechanics in physics. Knowledge systems are also subject to change through interaction with other knowledge systems. That is to say that they emerge and develop within a broader 'ecology of knowledge' that comprises multiple knowledge systems. Knowledge systems have come into contact through history, e.g., trade and commerce or migration. Contact with other knowledge systems may be benign in that it may lead to sharing knowledge and innovation in a mutually beneficial way. However, knowledge systems may also come into contact because of conflict and/or colonialism. A key point of contact between knowledge systems has been the spread of Western colonialism since the 15ᵗʰ Century. This led to the violent suppression of the knowledge systems of the colonised in a wider context in which their whole way of life was fundamentally altered through the imposition of new economic and political arrangements that favoured the colonial masters.

Western colonialism can, therefore, be seen to have precipitated the development of knowledge hierarchies and hegemonies. The knowledge systems that served the interests of the colonisers were considered superior and universal in their application and scope, whilst the knowledge systems of the colonised were delegitimised as being provincial and based on superstitious beliefs rather than on 'objective' truth. Scientific knowledge systems have become hegemonic during the European Renaissance (C14-C17), coinciding as it did with Western colonialism. It is, however, problematic to describe modern science as 'Western science' as is sometimes the case in the literature. Modern scientific knowledge drew extensively on knowledge and innovations from African, South American and Asian civilisations that predated the European Renaissance, whether in mathematics, medicine, astronomy, or environmental science. Often, these debts to other civilisations are barely acknowledged (Bernal, 1989; Harding, 2008; Saliba, 2007).

Modern science has also become dominant in relation to other disciplines. For example, economics and psychology are often premised on the idea that the social world, like the natural world, should be understood rationally and objectively using scientific, empirical methodologies. The way these disciplines have developed since the European Renaissance also reflects the predominance of specifically Western ways of thinking. For example, they often draw on Western, individualistic conceptions of human subjectivity that stand in contrast to the more collectivist understanding of human subjectivity that characterises many

African, Asian, Indigenous and other systems of thought. As Mbembe puts it, the 'universal scientific subject remains … a Western man, the product of a specific historical trajectory … It is this universality that needs to be questioned.' (Mbembe, 2001: 159).

From the above, it becomes clear that knowledge and research are never 'neutral'. Rather, knowledge systems reflect wider power relations within society and are linked to different interests. Modern science, for example, is far from neutral despite its claims to universalism and objectivity. Modern science has developed in the context of capitalism, patriarchy and colonialism and has served specific interests (Shiva, 2016; Harding, 2008). New technologies have often been used to maximise profit by replacing labour and have alienated workers from the natural environment and from the production process. Despite the potential for technology to support more equal societies and work in the interests of human flourishing, the relentless pursuit of profit under technology-fuelled capitalism has increased rather than reduced inequalities. The pursuit of technological mastery over nature has also facilitated new forms of violence over ecosystems and human populations (Mbembe, 2001; Shiva, 2016). The automation of production and the extraction of raw materials have led to the pollution of land, seas and rivers, whilst the reliance on fossil fuels has contributed to climate change. States have also often deployed modern science to develop means of violence that have been used against their own populations and in conflicts with other nations. For Mbembe, the particular form of scientific rationality based on the abstract and dispassionate extraction of knowledge makes it possible for modern science to be used instrumentally in support of specific interests. He argues that 'the history of modernity … coincides with the story of the progressive separation of humans from their environment … Science has played a critical role in this process …' (Mbembe, 2001: 63).

Modern science has also been misappropriated for ideological purposes, such as the development of the eugenics movement that served to justify racism and colonialism through the spurious claims that there exists a hierarchy in human aptitude based on 'race' with White Europeans at the top of the pyramid and Africans at the bottom (Gould, 1996). Despite the fact that eugenics has been largely discredited as a pseudoscience since its use in the holocaust to justify the supposed inferiority of Jewish people, Gipsies, and other populations, the idea that 'race' is a meaningful way of attributing differences in aptitude between human populations and that there exists a racial hierarchy that separates and defines people continues to fuel contemporary forms of racism today.

It is not just the way that modern science is used that makes it biased towards different interests. As is the case with the eugenics movement, there is scope for bias at all stages of the research process, from the way that research problems are framed, hypotheses are designed, methodologies are selected, indicators are constructed, and findings validated. For this reason, it is crucial to recognise the importance of ethical reflection at all stages of the scientific process. In this respect, there is also scope for bringing modern science into productive conversation with other knowledge systems that posit a more synergistic rather than abstract and exploitative relationship between human beings and the environment (Harding, 2008; Asabere-Ameyaw et al., 2012).

Within traditional societies too, knowledge systems are often linked to traditional power structures in which custodians of traditional knowledge have a designated status within a

formal hierarchy. As several scholars have argued, traditional knowledge systems and the traditional structures they serve may be patriarchal in nature (Khupe, 2014; Keane, 2008; Jackson, 2023) or linked to traditional rulers' interests. For this reason, whilst recognising the intrinsic worth of all knowledge systems, including IK systems, it is important to understand them historically in their material, social and cultural contexts and not to romanticise or idealise them.

The case for transforming knowledge and research

Given the damage wrought by centuries of European colonialism on the knowledge systems of many non-Western civilisations, a key motive for transforming knowledge and research is to seek to repair past injustices linked to the marginalisation and, in some cases, erasure of these knowledge systems. Four interrelated dimensions of epistemic justice are relevant here. All have implications for higher education and relate to different aspects of UNESCO's work, as will be discussed more fully in later sections. The first is to recognise the intrinsic value of all knowledge systems. This is an essential first step in repairing the injustices of the past. As suggested above, this aspect of epistemic justice needs to consider the cultural embeddedness of knowledge systems and their contributions to supporting and sustaining ways of life that communities have reason to value. Recognition of knowledge systems also needs to take account of their historicity, including their relationship to other knowledge systems. The contributions of different knowledge systems to just and sustainable futures also need to be recognised, including their relationship to the realisation of social and environmental justice.

The second aspect is concerned with ensuring that human beings have epistemic access to diverse knowledge systems. One of the implications of existing knowledge hierarchies is that learners are often exposed only to Western knowledge through the formal curriculum. When considered in relation to this dimension of epistemic justice, the view of an inclusive and good quality education at the heart of SDG4 must necessarily involve an education built on a pluriverse of knowledge systems rather than Western knowledge alone. Of relevance here is the issue of language. It has been suggested that language is how learners access diverse knowledge systems. This indicates that education should also be supporting the development of plurilingualism. The third aspect concerns redressing what Amanda Fricker (2007) describes as testimonial injustice, i.e., the extent to which marginalised communities' perspectives and lived experiences are seldom listened to or considered in formal educational settings (see also, Walker, 2019). Redressing testimonial injustice is also critical for the fourth dimension of epistemic justice, namely, to recognise human beings in our capacities as both knowledge takers and knowledge makers. As will be discussed below, this involves supporting the agency of human beings to engage critically with diverse knowledge systems in their role as knowledge takers and their agency as knowledge makers through their involvement in research. This dimension of epistemic justice underpins the necessity for communities to play an active, leading role in realising just and sustainable futures[3].

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[3] Amartya Sen's concept of human capability is relevant here, by which he means the opportunity freedoms and agency available to human beings to live the lives they have reason to value. In these terms, having access to relevant knowledge from different sources expands the opportunities available to people that will enable them to flourish and support the flourishing of natural systems and of other species. Sen A (1999) *Development as Freedom.* Oxford: Oxford University Press.

Closely linked to justice issues, there are practical, pragmatic reasons for transforming knowledge and research for just and sustainable futures linked to a rapidly changing context. Dealing with global challenges such as the fight against poverty, unsustainable cities and communities, unemployment, biodiversity loss and climate change are complex 'wicked' problems. Our ability to tackle these problems is enhanced if we can draw on diverse knowledge systems - or, in Mbembe's terms - all the world's archives. Some examples of impactful, transdisciplinary research that can draw on diverse knowledge systems to address complex problems of sustainable development are given in section three of the paper.

A further contextual reason for transforming knowledge and research is linked to the increasing impact of big data and technology, including artificial intelligence (AI), on societies. This offers both opportunities and challenges for realising just and sustainable futures. Recent scholarship (Williamson, 2017) on the impact of big data on education, for example, demonstrates the wider issues around the use of data in support of just and sustainable futures[4]. As Williamson argues, using big data in education can be beneficial in creating personalised learning plans for each student based on their strengths, weaknesses, and learning styles. This can help to improve student engagement and outcomes[5]. However, using big data poses many challenges regarding epistemic justice. To begin with, there are concerns about the privacy of student data, and it is essential to ensure that data are collected and used ethically. Data quality is critical for practical analysis, and ensuring that data is accurate and complete is vital. Educators need to develop the skills to analyse and interpret data effectively. There is a risk that big data could be used to exacerbate existing inequalities in education, and it is essential to ensure that all students have access to the benefits of big data.

The increasing use of educational technology, including during the COVID-19 pandemic, also draws attention to the possibilities and limitations of using technology in education (West, 2023). The pandemic led to forced progress in education, largely reliant on connected technology, which has propelled education into desirable digital futures. However, this experience was also characterised by imperfect salvation, where technology saved the day in an emergency but left many learners behind, supercharging inequalities. The uprooting of education to technology-reliant remote learning left most learners behind, resulting in low student engagement, poor achievement, and unhealthy immersion in technology. Additionally, ed-tech empowered private sector actors, enabled invasive surveillance and control, and had environmental impacts. The digitalisation of education led to commercialisation, treating teaching and learning as profit-driven activities. It also normalised constant surveillance and datafication of students and teachers. The report recommends leveraging technology for education while keeping schools and humans at the centre of teaching and learning. It emphasises the need to prioritise the best interests of students and teachers, centre the most marginalised, and re-engineer the logic and incentives guiding

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[4] Big data in education refers to collecting, analysing, and using large and complex datasets related to students, teachers, and the learning process. This data can come from various sources, such as student records (grades, attendance, standardised test scores), learning management systems (LMS), educational apps and games, online courses, social media, sensors and wearable devices.

[5] As Williamson argues, big data can identify students at risk of falling behind so that teachers can provide early intervention support and feedback. Big data can identify areas where resources are being underutilised or wasted so that they can be allocated more efficiently and inform educational policy decisions, such as curriculum development and funding allocation.

digital changes in the education sector. UNESCO has been actively involved in driving progress and addressing global educational challenges. It has led the drafting of documents and declarations to prioritise equitable, sustainable, and humanistic digital futures for education, emphasising the importance of content, capacity, and connectivity.

The increasing use of AI in knowledge and research also poses opportunities and threats to epistemic justice. As Williamson et al. (2023) argue, there are several opportunities associated with AI in education, including the potential for AI to enable personalised learning experiences, predict student outcomes, and provide actionable strategic intelligence. AI is seen as a means to radically transform teaching and learning, offering personalised learning experiences through collecting, analysing, and using large amounts of personal data[6]. One of the main threats is the potential for discriminatory designs in AI systems, which can lead to inequitable outcomes and misallocating opportunities and resources for various groups of students. The commercialisation of AI in education is also identified as a threat, with concerns about the active promotion of AI in educational settings by commercial companies and influential technology philanthropists and investors[7].

A recent UNESCO document (UNESCO, 2023) has provided guidance on the use of generative AI (GenAI) in education and research. It emphasises the need for regulations to govern the use of GenAI in educational settings, outlining key elements such as governmental regulatory agencies, providers of GenAI tools, institutional users, and individual users. Additionally, it highlights the importance of a policy framework to promote inclusion, equity, linguistic and cultural diversity, and to protect human agency. The document also emphasises the development of AI competencies, capacity building for teachers and researchers, and the promotion of plural opinions and expressions of ideas. Furthermore, it discusses the facilitation of responsible and creative use of GenAI in education and research, advocating for a human-centred and pedagogically appropriate interaction approach, co-designing the use of GenAI, and its application in research, teaching, and supporting learners with special needs.

Section two: Transforming Knowledge, Research and Education

Whereas the previous section made a case for why knowledge and research need to be transformed, this section addresses what needs to change if knowledge and research are to be radically transformed in the interests of just and sustainable futures. It considers three interrelated dimensions of transformation, namely transforming knowledge, transforming research and transforming higher education.

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[6] Furthermore, AI is recognised as a tool that can extend the capacity of data systems to perform predictive analytics and automated decision-making, thereby inspiring ideas about real-time, predictive, and even pre-emptive forms of automated governance in education. The chapter also addresses the potential for AI to prepare AI workforces and the need for AI education to enable countries to become digital superpowers. These opportunities are presented alongside critical perspectives and ethical considerations.

[7] Moreover, the chapter highlights unresolved ethical tensions and issues associated with AI in education, emphasising the need for more vital interdisciplinary collaboration and ethical principles in the development of AI in education. The authors also point out the risks of depoliticised, ahistorical, and asocial approaches to AI in education, failing to acknowledge the growing social, political, and ethical problems associated with AI.

Transforming knowledge

Transforming knowledge for just and sustainable futures requires moving away from a reliance on formal knowledge systems alone and creating new 'ecologies of knowledge'[8]. In relation to the earlier discussion, all knowledge systems can be considered a specific niche within a broader ecology of knowledge. The term is used to embrace the interconnectedness and interdependencies of knowledge systems and the possibilities for creating useful synergies between them analogous to a natural ecosystem. However, developing new knowledge ecologies requires challenging the dominance of top-down, expert-driven formal knowledge systems and their universalising assumptions. This poses philosophical and practical challenges.

At a philosophical level, the idea of ecologies of knowledge draws attention to how we perceive the nature of reality and of truth. Beliefs about the nature of truth and reality can be considered to lie on a spectrum. At the one end lies positivism, which argues that reality exists outside of our experiences and can be objectively measured and understood so long as robust scientific methodologies are used. However, as has been argued, even the most robust scientific methods are fallible and prone to bias and misuse. At the other end of the spectrum lies interpretivism, i.e. the belief that, as human beings, we entirely construct our own reality and that our understanding of reality is, therefore, relative. Many exponents of modern science defend the objective nature of reality and challenge the relativistic view that 'anything goes'. These efforts have become particularly pronounced in the popular media in debates about the reality of climate change and the efficacy of the COVID-19 vaccine, for example. Here, social media has played an invidious role in promoting 'pseudoscientific' explanations for changes to the weather that have fed into climate change denial, as well as in supporting an anti-vac campaign.

A potentially more helpful and convincing view of reality that is consistent with the arguments of this paper is provided by the philosophy of critical realism (Archer et al., 1998; Bhaskar, 2008; Bhaskar, 2010). Critical realists argue that whilst there is a shared reality outside of our individual experiences of reality, we socially construct our understanding of that reality from differing epistemological positions[9]. No knowledge system has innate superiority or a better vantage point than other knowledge systems. Epistemic justice demands that each needs to be understood and evaluated in its own terms in relation to its own internal criteria of validity whilst taking account of the wider historical and cultural context in which knowledge systems have emerged and developed over time. By the same token, as has been argued, all knowledge systems are also subject to biases linked to the effects of power relations. Furthermore, all knowledge systems, including modern science, are ultimately fallible. This last point is evidenced by knowledge systems evolving through methodological innovation or

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[8] In developing an understanding of the term 'ecologies of knowledge', the work of several scholars has been particularly useful Star L (2016) Revisiting Ecologies of Knowledge: Work and Politics in Science and Technology. In: GeoffreyC.Bowker S, Adele E. Clarke, Ellen Balka (ed) *Boundary Objects and Beyond: Working with Leigh Star*. Massachusettes: MIT Press, pp.13-46, Wojciechowski J (2009) *Ecology of Knowledge.* Washington: The Council for Research in Values and Philosophy, Akera A (2007) Constructing a Representation for an Ecology of Knowledge: Methodological Advances in the Integration of Knowledge and Its Various Contexts. *Social Studies of Science* 37(3): 413-441, de Sousa Santos B (2007) Beyond Abyssal Thinking: From global lines to ecologies of knowledge. *REVIEW* XXX(1): 45-89..

[9] Bhaskar, the originator of critical realism, embraced epistemic pluralism and drew on Western and Eastern philosophical traditions in developing his ideas.

encounters with other knowledge systems. The value of different knowledge systems in relation to realising just and sustainable futures lies in the extent to which each can contribute, along with insights from other knowledge systems within a wider ecology of knowledge, towards a theoretical understanding of underlying causal mechanisms that give rise to complex reality and in their ability to solve real-world problems. Different knowledge systems may be more or less suited to solving different problems.

This is, therefore, not an argument for 'rejecting' knowledge contained within formal knowledge systems. Disciplinary knowledge, for example, has evolved over centuries and, as has been argued, has drawn on insights from many civilisations, even if they have taken their modern form in the context of the development of capitalism, patriarchy and colonialism. They encapsulate specialised, systematic knowledge of the natural and social worlds related to discrete areas of human activity. They provide an invaluable resource (along with other knowledge systems) for developing new ecologies of knowledge. However, if the disciplines are to play such a role, they need to be transformed in order to ensure that they are not universalising in their assumptions and exclusionary of other ways of understanding the world. In the case of science, as Asabere-Ameyaw and colleagues have argued (2012), there is much that can be learned from Indigenous African approaches to science that they have termed a 'science of the social', i.e. an approach which integrates an understanding of the natural world with a fundamental belief in the interconnectedness of human beings with each other but with past and future generations and with all living things (see also Harding, 2008). These ways of thinking about the natural and social worlds are also evident in other traditional knowledge systems.

Consistent with the philosophy of critical realism is the idea that, as knowledge makers, we are also subject to biases linked to our own position and enculturation within specific knowledge systems. This demands that we are suitably self-reflexive in our roles as knowledge-makers. For the gatekeepers and guardians of formal knowledge systems, this demands exercising what Srivastava (2022) has described as 'epistemic humility'. As knowledge-makers, we also have the duty to act ethically. Here, it is useful to invoke Mbembe's idea of new planetary consciousness, not as a universalising set of assumptions about the nature of truth or reality (as has sometimes been the case in the development of modern science) but rather as an emerging awareness of the interconnectedness of all living things, the existence of planetary boundaries and of the need to care for, repair and share our planet. This view of knowledge has significant implications for research and public education.

Expanding and Transforming the Knowledge Commons

As knowledge makers, all human beings have the potential to make use of insights from diverse knowledge systems to realise transformative change. Here it is imperative that the knowledge generated by research remains a public good and a part of the knowledge commons. As knowledge takers, all human beings have the right to access the knowledge commons. However, considering the discussion of epistemic justice, our conception of the knowledge commons must be expanded and transformed. The idea of the knowledge commons, as it is used today to refer to the democratic right to access knowledge, is often traced back to the anti-enclosure movement in England between the 16th and 19th centuries and to the American tradition of shared spaces and democracy that emerged in the context of the American Revolution. From the mid-20th Century, the term 'knowledge commons'

gained wider recognition in the West during the rise of open-access movements in science and academia. These traditions sought to defend the idea of knowledge as a common good in the context of expanding intellectual property rights and privatisation. However, if the term is to play a helpful role in the contemporary debate, there is a need to decentre contemporaneous Western-centric understandings of the term.

Many other cultures and civilisations over millennia have emphasised the idea of knowledge as a common good. Indigenous cultures, for example, practice intricate systems of knowledge sharing and resource management, prioritising community needs over individual benefit. Traditional ecological knowledge, agricultural practices, and healing techniques are passed down through generations, emphasising communal ownership and collective responsibility. Examples include the Maori concept of "kaitiakitanga" (guardianship) over natural resources, the Andean Qhapaq Ñan network of knowledge exchange, and the intricate communal land management systems found in Africa and Asia. Non-Western cultures are often characterised by oral traditions and collaborative storytelling for knowledge transmission. This emphasises collective creation, shared ownership, and continuous adaptation of knowledge through dialogue and debate. Epic poems, folktales, and rituals are repositories of history, cultural values, and practical knowledge, ensuring accessibility and engagement for all community members.

As discussed further below, UNESCO has played an instrumental role in these movements. The digital era has also fundamentally transformed how we conceive of the knowledge commons to encompass how data is shared and governed. The rise of digital technologies and the internet sparked many knowledge commons initiatives. Open-source software, mass online education and training programmes, Wikipedia, and Creative Commons licenses have become prominent examples of sharing and collaboration in the digital realm. Corporate interests have played a significant part in many of these initiatives. However, the private sector poses several threats to knowledge commons. Commercial interests can enclose knowledge through patents, copyrights, and paywalls, restricting access and stifling innovation. This commodification can also distort research priorities, favouring profit over societal benefits. Moreover, powerful tech companies can control online platforms, manipulate information, and shape public discourse, undermining the free flow of ideas central to the commons. These tendencies create knowledge inequalities and stifle the collaborative spirit at the heart of the commons.

In this respect, as Lotz-Sisitka (2017) notes, environmental and social justice movements have championed the common good and reclaiming resources from neoliberal forces for many years. Leaders like Vandana Shiva (2005) advocate for "Earth Democracy," linking environmental justice and sustainability to the democratisation and de-commodification of Earth's material and immaterial resources, like water, seeds, and knowledge. This broader interpretation of the commons, encompassing people and the planet, is critical to achieving true environmental justice and sustainability. Such an expanded view of the knowledge commons also links closely to Mbembe's view of a new planetary consciousness emerging from all of the archives of the world. In Mbembe's terms, a transformed knowledge commons would seek to 'multiply bridges and passages so that there can be encounters, and that together we can finally free ourselves from the univocal visions of history and, even more,

from the colonial temptation to always want to hierarchise beings, cultures and things" (Mbembe, 2023: 3).

It is important, however, not to have an idealised view of a knowledge commons as a 'real' global entity, given that what might be considered as the knowledge commons straddle national borders and diverse interests, including private interests and increasingly has to contend with intellectual property laws at national, regional and global scales. Rather, Lotz-Sisitka (2017) argues for a view of 'commoning as a process' which recognises the struggles of Indigenous and other groups to maintain intellectual property right over their knowledge but is also centrally concerned with the educational process of empowering communities with the knowledge and agency required to transform their lives. It will be argued below that both the higher education sector and UNESCO have an important role in facilitating commoning as a process underpinned by principles of epistemic justice.

Transforming research

In practical terms, transforming knowledge along the lines suggested above requires bringing the disciplines into critical conversation with informal and traditional knowledge systems through transdisciplinary research processes. In their recent review, Lawrence et al. (2022) characterise transdisciplinary research as pursuing theoretical explanations of reality across disciplines and knowledge systems, transcending traditional academic boundaries. It, therefore, encompasses multidisciplinary, interdisciplinary research, making use of mixed methods and actively involving non-academic societal actors in the process. Knowledge co-creation can ensure that the solutions generated are contextually relevant and achieve ownership amongst the intended beneficiaries of the research, along with policymakers and practitioners responsible for implementing change. Transdisciplinary research is distinguished by its focus on complex, real-world problems that are societally relevant, working in a transformative manner to understand these issues and support proactive actions or interventions. It emphasises the common good, aiming for societal betterment and upholding human dignity and life. Additionally, transdisciplinary research is marked by a strong sense of reflexivity, in which participants in the research process constantly consider the broader context and ensure the compatibility of all project components, methodologies and tasks throughout their duration (DeJaeghere, 2024). However, as will become clearer in the discussion in the next section, a transdisciplinary approach poses several practical, methodological and ethical challenges that must be overcome. In this regard, the description of transdisciplinary research presented above needs to be considered more as an ideal towards which research teams can aspire. The examples in the next section illustrate that each exemplifies the characteristics of transdisciplinary research in different ways and to differing degrees.

As suggested, human beings' changing relationship with technology has huge implications for how we conceive of the knowledge commons and undertake research. A recent UNESCO publication (UNESCO, 2023) has argued strongly for a human-centred approach to integrating technology, including AI, into the research process. This involves, on the one hand, conducting research that can illuminate the opportunities and challenges involved in the use of technology for just and sustainable futures. The recent report entitled *An Ed-tech Trajedy? Educational Technologies and school closures in the time of COVID-19* (West, 2023) provides an example of exactly this kind of research, illuminating as it does the opportunities but also

the harmful effects on education quality and equity arising from the use of educational technologies within an increasingly privatised landscape. The second aspect is the potential to integrate new technologies, such as AI, into the transdisciplinary research process itself, although these developments are still in their infancy[10].

Transforming Education

In this section, attention will turn to the implications for education of the above discussion. By education, the point of reference is education systems conceived broadly to encompass formal institutions and informal and social learning in communities. As the example of the Transforming Education for Sustainable Futures network makes clear, transformative change can best be facilitated by breaking down the silos not only between sub-sectors of education and training but between formal educational institutions and the communities that they serve. This leads to a more expansive view of public education systems as traversing formal, informal and virtual spaces. As the TESF project suggests (below), there are several ways in which education systems, broadly conceived, can contribute to the transformation of knowledge and research suggested above and the realisation of a knowledge commons. These are expressed as broad, system-wide priorities rather than specific recommendations or a one-size-fits-all approach. How these might be re-articulated and implemented varies according to context, the particular legacy of education, the individual needs, the age of learners and their stage in the learning process, etc.

A starting point is to decolonise education. Mass education systems were often introduced under colonialism and Western influence and bear the imprint in how formal, modern education systems are structured and function. The primary purpose of education under colonialism and in the postcolonial era has been to serve the interests of colonial masters and Indigenous elites by producing human capital imbued with the necessary attitudes, norms and values to make them economically useful and politically docile. The coloniality of modern education systems is reflected in the Eurocentric nature of the curriculum. It is also evident in the rigid structuring of the school day according to Western, linear conceptions of time, the predominance of teacher-centred, top-down, and authoritarian approaches to pedagogy, and the institutionalisation of violence.

The colonial legacy is reflected in the separation of formal education institutions from the community. This separation is reflected physically in the separation of the school, college or university as a site of learning from the forms of learning in communities. It is also reflected at an epistemic level in the separation of the knowledge valued and relayed in the formal curriculum, the languages in which the curriculum is conveyed, and the knowledge and languages contained in the community. Modern education systems, like their colonial forebears, remain elitist and continue to exclude learners based on class, caste, race, gender,

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[10] For example, the Pachamama project (https://pachama.com/) uses an AI platform to analyse satellite imagery and other data to monitor deforestation and track carbon offsets. Farmers can use Pachama to implement sustainable practices and earn carbon credits, creating a financial incentive for protecting the environment. The project involves a partnership with the Amazonian indigenous organisation COICA to develop a more culturally appropriate and inclusive approach to monitoring deforestation. This collaboration aims to ensure that local communities have a say in monitoring and protecting their territories and that the project's benefits are shared equitably.

ethnicity, language disability, rurality, etc. The use of technology in the context of the COVID-19 pandemic has deepened the digital divide and has exacerbated rather than reduced these inequalities. As discussed, technology has also often been used as a means for the surveillance of learners and educators. It has promoted forms of racial and gender profiling that have served to deepen inequalities further. The urgent task facing policymakers, practitioners, activists and all stakeholders involved is to transform education so that it becomes a vehicle, not for the development of human capital that can serve the interests of capitalist modernity but a vehicle for realising, in Mbembe's terms, a new planetary consciousness. How might this be achieved?

Firstly, the curriculum needs to draw attention to the colonial legacy in education and society, decentering the Eurocentric bias of the formal curriculum and instead drawing on diverse knowledge systems. Decolonising approaches also argue for reparative pedagogies that can use an understanding of the effects of the colonial legacy, racism, slavery, etc., to open up possibilities for reparative futures (Sriprakash et al., 2020; Paulson, 2023; Walker, 2023). Education should foster plurilingualism and translanguaging so that the value of all languages represented in the community is recognised and can be used as a basis to enable learners to access diverse knowledge systems (Milligan and Tikly, 2016; Garcia and Wei, 2014). There is a concomitant need to decarbonise education. That is, to use the curriculum to focus on sustainability and planetary well-being. Education should go beyond traditional academic disciplines and explicitly integrate sustainability-related knowledge and values. This includes environmental awareness, ecological stewardship, responsible consumption, and understanding the interconnectedness of social, economic, and environmental systems. Here, IK systems uniquely contribute to sensitising learners to the fundamental interconnectedness of humans with each other, the natural world and the world of things, including technology.

Education should also reject pedagogies focused on rote memorisation and instead equip students with the critical thinking skills necessary to analyse complex problems, evaluate information, and develop innovative solutions for the challenges of the 21st century. A useful concept in thinking about education in relation to epistemic justice is that of pedagogical border crossing. Teaching and learning must start with recognising and valuing the local and IK and languages the learner brings as a foundational basis for exposing learners to other knowledge systems. Education should engage learners in crossing between knowledge systems, encouraging learners to understand and respect the history, integrity and distinctiveness of diverse knowledge systems, their inter-relatedness, and the possibilities for synergies. Accessing informal and traditional knowledge systems requires traversing pedagogical sites between formal and informal pedagogical spaces, including land- and place-based learning opportunities. Learning should be a collaborative process where students, educators, and local communities work together to identify challenges, co-create solutions, and share knowledge. This empowers communities to become agents of change and ensures education addresses their specific needs and contexts. Educators need to be empowered through initial and continuing professional development as agents of change, equipped with the necessary skills and knowledge to guide students towards sustainable thinking and action. This requires ongoing professional development opportunities that focus on sustainability education and community engagement.

Education must, therefore, dismantle barriers to access and promote inclusion for marginalised groups. This involves addressing gender inequalities, tackling discrimination based on race, ethnicity, or disability, and ensuring quality education reaches all, regardless of their background or circumstances. Technology can be a powerful tool for promoting access to education, facilitating knowledge exchange, and engaging students in real-world problem-solving. However, ensuring equitable access and responsible use of technology in education is crucial. All forms of violence, including gender-based, racialised and disabled violence, but also more recent forms of violence, such as cyberbullying, need to be eliminated. Rather, education should cultivate empathy, compassion, and respect for diversity. It should promote values like peacebuilding, conflict resolution, and global citizenship, guiding students towards actions that contribute to a just and sustainable future for all. Education should not be confined to traditional classrooms or specific life stages. It should be adaptable and accessible throughout life, offering diverse learning pathways and fostering a culture of continuous learning and knowledge sharing. Underlying all the above is a need to reaffirm the role of education as fundamentally a public good and central to the realisation of a knowledge commons. This requires challenging the increasingly instrumental role assigned to education in the context of neo-liberalism.

Section three: Reimagining knowledge and research

The aim of this section is to provide some illustrative case studies of transdisciplinary research across different areas of sustainable development. Each has been chosen to illustrate overlapping but distinctive aspects of transdisciplinary research. The first example illustrates the work of the Intergovernmental Panel on Climate Change (IPCC). It highlights the challenges of conducting transdisciplinary research at a global scale and integrating modern scientific and IK while maintaining the 'objectivity' of the assessment reports required to influence governments. The work of the One Ocean Hub addressed similar issues of integrating modern scientific and Indigenous Knowledge (IK). Still, it addressed these challenges in a bottom-up and genuinely co-creative way. The Transforming Education for Sustainable Futures network demonstrates the power but also the challenges involved in conducting genuinely co-creative research and the need for an ethical approach. It illustrates the central importance of education in achieving sustainable futures and capacity mobilisation as an essential component of successful transdisciplinary and co-creative working.

Example one: The Intergovernmental Panel on Climate Change

Launched in 1988 from a joint effort of the World Meteorological Organization and the United Nations Environment Programme, the Intergovernmental Panel on Climate Change (IPCC) emerged as a global bridge between science and policy on climate change. Its mission is to provide governments with scientific information to make informed decisions about this pressing issue. Through comprehensive assessments, the IPCC seeks to shed light on the physical science of climate change, its impacts on societies and ecosystems, and potential pathways for mitigation and adaptation. The IPCC's annual assessment reports are crafted meticulously and collaboratively, incorporating diverse perspectives. It starts with scoping meetings to define the report's outline, followed by expert teams drafting chapters based on the latest scientific literature, data, and IK. Drafts undergo rigorous peer review by governments and scientists, leading to revisions and line-by-line approval by the IPCC panel. This scientific synthesis, compiled by thousands of expert volunteers from diverse disciplines, serves as the cornerstone for international climate negotiations and national policy

frameworks. In essence, the IPCC acts as a trusted guide, illuminating the science of climate change and empowering governments to chart a course toward a sustainable future.

However, whereas the IPCC has been relatively successful in integrating diverse disciplinary perspectives, the success of the Panel's engagement with IK has been more mixed. Growing recognition of IK, evident in references to IK across recent reports (IPCC, 2023a; IPCC, 2023b), showcase efforts to integrate IK into assessments. Collaborative projects, case studies highlighting successful adaptation strategies based on IK, and regional workshops dedicated to IK integration mark advancements. However, challenges persist in bridging methodological differences and addressing power imbalances. Realising IK's potential requires deeper collaboration, equitable partnerships, and robust methodologies respecting IK's unique characteristics.

Example two: Expanding Ocean Science through Integrating Scientific and Indigenous Knowledge: The Work of the One Ocean Hub

The [One Ocean Hub](#) represents a transformative approach to the challenges of integrating scientific and IK to foster a healthier ocean. This project stands out for its commitment to inclusive decision-making, blending academic expertise with local insights through a co-design approach. This methodology bridges the gaps between science, law, and policy and actively involves communities in transdisciplinary research. The aim is to develop balanced solutions that consider both conservation and multiple ocean uses, thereby empowering marginalised voices and advocating for a sustainable ocean future. Central to the Hub's philosophy is the rejection of a uniform research approach. Instead, it adopts knowledge co-production, where scientific experts and local communities collaboratively create knowledge. This process involves framing research questions together, employing collaborative methods like citizen science, and co-creating tools. The approach ensures academic rigour while meeting local needs and addressing power imbalances to ensure equitable participation. A key priority for the One Ocean Hub is the integration of IK into its research framework. Recognising the unique ecological and cultural insights of IK, the Hub involves Indigenous communities in co-designing research questions and employs inclusive methods like art-based projects and storytelling. This integration enriches scientific understanding and community resilience, aiming for a just, sustainable ocean future that respects diverse knowledge systems.

Despite its relatively recent inception, the One Ocean Hub's impact is significant. It has created a dynamic knowledge ecosystem, facilitating the co-creation of understanding of various ocean issues between researchers and coastal communities. Through One Ocean Learn, a digital platform, and the DEEP Fund, the Hub disseminates knowledge and influences decision-making at various levels. It challenges existing power structures and strives for transformative ocean governance. The Hub's efforts are amplified through public engagement and media, inspiring broader participation in its innovative, equity-centred approach. However, the Hub's transdisciplinary approach is not without challenges. Navigating power imbalances, ethical considerations, and the integration of IK requires careful and respectful strategies. Building community capacity is a long-term commitment essential for equitable participation in research.

Example three: Transforming Education for Sustainable Futures

The Transforming Education for Sustainable Futures (TESF) network, funded by the UK's Global Challenges Research Fund (GCRF), was a collaborative initiative involving partners from India, Rwanda, Somalia/Somaliland, South Africa, the Netherlands, and the UK. Initiated in 2019 and concluded in 2023, TESF aimed to understand how education could be transformed to support sustainable livelihoods, cities and communities, and climate action. Notably, the network prioritised tackling intersecting inequalities within these contexts, including those based on gender, socioeconomic status, race, class, language, coloniality, and Indigeneity. Projects engaged with academic knowledge and embraced Indigenous and local knowledge held by communities, alongside professional expertise and practical know-how from practitioners, policymakers, and other stakeholders. Harnessing the agency of educators, learners, communities and policymakers through participatory methods was key to the success of the projects. This emphasis on different forms of expertise aimed to transgress traditional top-down research models, often characterised by knowledge hierarchies that marginalise non-academic knowledge.

Examples of this transdisciplinary approach included projects in Rwanda equipping disadvantaged groups like young women and the deaf/blind community with skills for better employment and initiatives across the network emphasising life skills like critical thinking, digital literacy, and entrepreneurship. Projects in India and South Africa investigated the link between education and urban development, while initiatives across all four countries aimed to equip individuals with skills to address urban challenges. Food and water security were also addressed, with projects exploring urban food gardens and community water management in India and South Africa. Importantly, Education for Sustainable Development was integrated into curricula across Rwanda, India, Somalia/ Somaliland, and South Africa, often employing participatory approaches to empower communities and promote climate action.

Recognising power imbalances inherent in research partnerships, TESF advocated for practices that ensured greater equality and ethical conduct. These included shared ownership and leadership, collaborative research co-created with communities, and empowering Southern partners through capacity development based on mutual learning rather than a deficit model. TESF also emphasised research designed to challenge existing power structures and inequalities, conducted ethically and transparently, with due attention to informed consent, data protection, and intellectual property rights. Furthermore, the network actively built long-term partnerships with local NGOs, government agencies, and community groups, ensuring research informed by local realities and serving as a positive change tool. TESF's commitment to mobilising capacity equipped local researchers and community members with research skills, data analysis tools, and communication know-how, empowering them to become active participants in knowledge production and utilisation.

Between them, the examples draw attention to the potential of transdisciplinary research for realising more just and sustainable futures. Each of the initiatives outlined has demonstrated the power of bringing together different knowledge systems to tackle complex and diverse problems of unsustainable development, whether the topic is adaptation and mitigation to climate change, governing our oceans or transforming education for just and sustainable futures. The One Ocean Hub and TESF examples also illustrate the value of genuinely co-creative approaches based on principles of equitable and ethical partnership working,

decolonisation and capacity mobilisation for overcoming the practical and ethical challenges of engaging diverse participants in the research process.

The examples also illustrate some of the real challenges involved and point to the need for a more fundamental transformation of the wider knowledge ecosystem as a necessary condition for supporting transdisciplinary research based on knowledge co-creation and equitable partnerships. In the case of the work of the IPCC, there are significant issues about the extent to which IK has been genuinely integrated into assessment reports. A recent analysis of the reports has found that whilst there are an increasing number of references related to Indigenous Peoples and their knowledge systems 'the IPCC still perpetuates a reductionist approach that reinforces harmful stereotypes. Overcoming this weakness requires greater reflexivity and concrete actions, including consistent recognition of Indigenous Peoples' rights, refraining from merely portraying Indigenous Peoples as vulnerable and adopting a strengths-based approach, ensuring ethical and equitable application of Indigenous Peoples' knowledge systems, and involving Indigenous Peoples from the scoping process. By implementing these measures, the IPCC can improve its partnership with Indigenous Peoples in preparation for AR7' (Carmona et al., 2023: 1).

The One Ocean Hub project emphasises the need for a sustained engagement with Indigenous communities at all phases of the research process is necessary and the fundamental importance of ensuring that the research itself contributes meaningfully to the realisation of Indigenous People's rights. Carmona et al.'s critique of the IPCC also draws attention to issues within the wider ecology of knowledge in which the assessments take place. For example, the peer review process involved in developing the assessment reports is heavily skewed towards individuals enculturated in the disciplines of modern science. Ensuring equity in publishing research findings also means allowing different modalities of presenting research findings according to different knowledge systems and methodologies. This requires changes to traditional processes of peer review but also to other aspects of quality assurance, such as citation practices (see, for example, Priyadharshini, 2023: on way of citing and quoting IK consistent with IK systems). A challenge facing the IPCC is the widespread perception that modern scientific approaches alone can generate the 'objective' evidence needed to convince policymakers about the need for climate action. There is, therefore, a need for an educational effort targeted at the research community, policymakers and the wider public about the value of integrating Indigenous Perspectives into our understanding of climate change, adaptation, and mitigation.

Section Four: Transforming Knowledge and Research- the Role of UNESCO

As Mbembe noted in his plenary address, UNESCO is uniquely situated as an international organisation to facilitate the evolution of a new planetary consciousness, given its historic mission from its inception in 1945 to build enduring peace through education, science, and cultural understanding. This section discusses the potential role of UNESCO in supporting the transformation of knowledge and research as envisaged in this paper.

UNESCO and the Political Economy of Knowledge Production
A starting point is to consider how UNESCO is uniquely situated within the wider political economy of knowledge production as it is in relation to his wider political economy that new

ecologies must emerge. It is also in relation to this wider political economy that the global knowledge commons is situated and must be protected and expanded. Understanding this wider political economy of knowledge production requires considering diverse interests, which determine how knowledge is produced, circulated, and governed.

Publicly funded higher education institutions produce much research. They also have a significant role in governing knowledge production through their involvement in processes of peer review as well as through their own internal processes, such as ethical procedures. Publicly funded education systems are also a key means for disseminating knowledge and, in the case of higher education, for developing research capacity. Governments, particularly in high-income countries, are a major source of research funding through funding councils. National and increasingly regional governments also have a key role in governing the production of knowledge through, for example, intellectual property legislation, competition law, and regulation of access to different kinds of knowledge. In the context of neoliberal globalisation, the private sector plays an increasingly significant role in the knowledge production cycle.

The private sector funds research through its own research, design and innovation processes. Multinational corporations, as has been discussed, have a prominent role in relation to the production and dissemination of digital content. Publishing houses have a crucial role to play in the dissemination of knowledge. The private sector also has an increasing role in providing education at all levels. Public and privately funded education is a vast marketplace for a range of private interests, from the production of textbooks and learning materials to educational technologies. Although the role of the private sector is mainly driven by profit, it largely depends on the public sector providing the knowledge and skills required to meet its own knowledge needs, for example, through the knowledge and skills produced by publicly funded higher education. Publishing houses rely on publicly funded academics for the content they sell at a profit and to support the peer review process.

The third sector also has a prominent role in the knowledge production cycle. Philanthropic organisations have become a major source of research funding and dissemination linked to their philanthropic goals. NGOs, INGOs, Trades Unions, faith-based organisations and CBOs also commission and undertake research. The latter also have an important role in circulating knowledge through their own activities or involvement in education. Membership-based professional associations have an important role in the development of professional and ethical guidelines that impinge on knowledge production. Between them, third-sector organisations vary considerably in their ability to undertake research but also in their involvement in research governance. Whereas large philanthropic organisations are increasingly prominent players in the knowledge production process, socially marginalised groups, such as Indigenous Peoples and their organisations, have a more minimal role and are, therefore, more susceptible to commercial and other interests. This is evident, for example, in relation to intellectual property.

As is the case for other UN organisations, UNESCO can be considered a public organisation in that it is funded by and accountable to member states. The mandate of UNESCO is also fundamentally about advancing the public good through promoting the public good. Nonetheless, as part of its mandate, it straddles public, private, and third-sector interests.

Through the work of UNESCO's national commissions and its various programmes, as well as its influence on other global organisations, it can operate at a number of scales. Although largely reliant on funding and accountable to member states representing diverse interests and perspectives, it is nonetheless well placed to play a leading role in transforming knowledge and research and protecting and expanding the knowledge commons, as discussed below.

Protecting and Expanding the Knowledge Commons

As an organisation, UNESCO is well placed to take a leading role in expanding and protecting the knowledge commons going forward. Since its inception in 1945, UNESCO has championed open access and knowledge sharing through, for example, promoting a Global Open Access Week, its Memory of the World and Information for all Programmes, and its UNESCO library database. It introduced its own open-access policy in 2011. The recent initiatives on open science and the use of AI (UNESCO, 2023) advocate strongly for the principle of knowledge for the common good of humanity and the planet. UNESCO also provides some support for processes of commoning (Lotz-Sisitka, 2017) through, for example, its Local and Indigenous Knowledge Systems (LINKS) programme, which advocates for IK and language rights and the inclusion of IK in global climate science and policy processes.

This work can be further expanded considering the arguments of this paper. For example, UNESCO could further broaden its policy advocacy in protecting and expanding the rights of marginalised groups to access the knowledge commons and to protect their intellectual property from corporate interests. It can also use new technologies like AI to expand the scope and functionality of its digital resource space to be more inclusive of diverse knowledge systems and languages and to facilitate intercultural dialogue and exchange. It can engage as an organisation with marginalised communities to mobilise their capacities as knowledge producers and to support the development of marginalised languages. It can also further invest in programmes aimed at bridging the digital divide. UNESCO can also advocate with member states and regional bodies to ensure legislative protection for the intellectual property of marginalised and other groups and in support of open access to the knowledge commons. It can also engage with the private sector to leverage open-access resources and funding to support open-access initiatives.

Nurturing new ecologies of knowledge through international research collaboration
UNESCO has a long track record of supporting international research collaboration through the UNESCO Chairs/ UNITWIN programme[11]. The new strategic focus on the role of UNESCO

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[11] The programme was launched in 1992 in response to the perceived need to reverse the decline of higher education institutions in low- and middle-income countries (LMICs). It aimed to strengthen inter-university cooperation through the creation of an innovative modality for regional and international academic cooperation. The key here was the idea of knowledge transfer between institutions to bridge the knowledge gap, encourage academic solidarity, assist in the establishment of centres of excellence in LMICs, and stem the brain drain from low to high-income countries. Implicit in the early conception of the model was that knowledge transfer should take place largely from institutions in the global North to those in the global South. The Programme has evolved and grown steadily in terms of the number of established Chairs and Networks and now involves more than 850 institutions in 117 countries. Today, UNESCO Chairs and UNITWIN networks are conceived by UNESCO as members of UNESCO's 'extended family' and recognised as intellectual partners of

Chairs and UNITWIN networks as think tanks and bridge builders linked to the realisation of the SDGs has important implications for the role of the UNESCO Chairs and UNITWIN programme in wider processes of transforming knowledge and research. Indeed, there are outstanding examples of transdisciplinary research networks that integrate diverse partners and knowledge systems based on principles of knowledge co-creation and equitable partnership working (Tikly, 2022). These span diverse topics, from education, arts, culture and peace to humanitarian engineering, complex systems transformation, sustainable urban living, human water systems and refugee rights. There is scope to expand these networks to encompass other areas relating to just and sustainable futures. To facilitate this shift, however, would require moving beyond the original core purpose of the programme, which was to strengthen the capacity of, particularly Southern-based universities, to one of nurturing new ecologies of knowledge through transdisciplinary working.

In adopting such a role UNESCO would need to take account of the wider political economy within which new knowledge ecologies might emerge. UNESCO must play a leading role in advocating for more equitable funding mechanisms on the part of donors and funding agencies. This ought to include, for example, advocating for more funding accessible by Southern-based researchers, including those in the third sector, so that they can lead research. Advocacy must also target the peer review process that continues to be biased towards mono-disciplinary and Northern-led research. Related to this is the need to establish more research funding councils in countries of the global South and to develop capacity in the practicalities of conducting transdisciplinary research. A priority must be for UNESCO to critically evaluate its own research processes, particularly with reference to how inclusive they are of diverse knowledge systems, methodologies and modalities for relaying research findings.

Transforming Education for Just and Sustainable Futures
UNESCO can play a critical role in transforming the way knowledge is produced and disseminated through its education mandate. Protecting education as a public good is an important first step in ensuring access to the knowledge commons for all learners. Reimagining public education along the lines suggested in the previous section also has implications for framing the right to education, particularly SDG 4. For example, inclusive education must relate not only to issues of access for marginalised groups, as has historically been the case in the Education for All Movement, but to epistemic access, including the representation of diverse knowledge systems in the curriculum and the languages through which the curriculum is accessed. The meaning of good quality, lifelong education also needs to be fundamentally re-evaluated so that it is synonymous with the idea of a new planetary consciousness.

Conclusion
The paper has sought to consider the implications of Mbembe's call for a new planetary consciousness for how we conceive of knowledge and research. It has been suggested that it has profound implications not only for knowledge and research but also for education. UNESCO is well-positioned to lead these important debates. In so doing, it should seek to

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the Organization. Individually and collectively, they bring a wealth of knowledge and expertise to UNESCO's programme.

foreground the voices and lived experiences of those who have historically been the victims of epistemic injustice, including Indigenous Peoples and other marginalised groups.

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