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Social and Ecological Engagement in Design (SEED): A novel integrative approach for just transitions to the Symbiocene

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Abstract

Is human-centred design still fit for purpose, or is it time for a new, more sustainable approach to how we design everything – from cereal boxes to political policies?

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Earth scientists now argue that we are leaving the Holocene epoch and entering a new geological epoch called the Anthropocene (Steffen et al. 2007). The design process and the outcomes it contributes can be considered part of the problem in the Anthropocene – from coal fired power stations, to fossil fuel powered motor cars, and the proliferation of plastic products (Boyden 2004). Arguably, an anthropocentric mindset in the design professions – as illustrated by the concept of 'human-centred design' – must be reassessed (Forlano 2016; Coulton and Lindley 2019; Jones 2022). Given the Triple Planetary Crisis (climate change, biodiversity loss and pollution), we need to rapidly transition to design approaches that foster the wellbeing of people and the planet (Boyden 2004). At Western Sydney University, we are developing a novel design approach called *Social and Ecological Engagement in Design* (SEED) that integrates social and ecological considerations in design thinking. SEED provides a structured approach to enable students to think more holistically about contemporary societal challenges and to identify positive sustainable outcomes. We envisage SEED as a design methodology to enable just transitions from the Anthropocene to the Symbiocene.

Introduction

With the catastrophic bushfires in Australia in 2019–20, and subsequent floods that devastated Australian east coast communities in 2022, many Australians have become increasingly concerned about climate change. Beginning with the Australian east coast flooding, one of the worst in the nation's history, 2022 also saw environmental catastrophes around the world, including a succession of severe flooding in Brazil in February (Alcântara et al. 2023) and massive floods in Pakistan in August (Nanditha et al. 2023). These unprecedented events highlight how natural disasters are having a severe impact on global populations, extending beyond immediate loss of life and property, and creating serious issues around food security, malnutrition, infectious diseases, and affecting access to education and healthcare. The Northern New South Wales floods of 2022, and the staggering $5.7 billion in insurance losses, serve as a reminder of the escalating frequency and severity of these natural disasters (Power and Callaghan 2016; White 2023; Insurance Council of Australia 2023). This alarming trend underscores the intricate link between local environmental challenges, human interaction with the natural world, and the broader global climate. For local communities, these incidents are part of complex social and political issues that extend far beyond the immediate and visible destruction.

Drawing from international examples underway that support communities to adapt to climate impacts, *Cultural Mapping as Cultural Inquiry* (2015) points to a range of interdisciplinary practices that have been strategically developed for cultural sustainability, supporting communities to visualise local stories and their intrinsic connection to place (Duxbury et al. 2015). Whilst these efforts are encouraging, in this paper we examine the need for an adaptive and transformative design approach that engages communities and empowers cultural and systemic change. As designers, it is critical that we reassess a human-centred design framework and bring together the *social* and *ecological* imperatives to ensure holistic design outcomes via a planetary health-centric methodology.

As academics, educators and design practitioners, we have recognised a responsibility to educate and offer our students meaningful ways to address the scale and multitude of social and environmental challenges. Emerging evidence suggests that many young people are increasingly overwhelmed and experiencing 'psychological distress' resulting from the adverse effects of climate change, which can evoke strong emotions such as concern, guilt and a sense of hopelessness; encapsulated by the term 'eco-anxiety' (Léger-Goodes et al. 2022).

In response to this, the *Social and Ecological Engagement in Design (SEED)* methodology aims to ensure the voices and insights of relevant stakeholders (and in the case of universities, our students) are heard, and they are offered the opportunity to build comprehensive and culturally sensitive eco-design outcomes.

This is underscored by *A systematic review of climate change education* (Rousell and Cutter-Mackenzie-Knowles 2019), which recognises the necessity for participatory, interdisciplinary, highly collaborative processes between students, educators, professionals and community members – to come together, share their unique perspectives, and co-create affect-driven sustainable approaches. Cutter-Mackenzie and Rousell (2019) observe that prevailing methodologies predominantly adopt a top-down perspective, emphasising scientific knowledge and cognitive comprehension. The review emphasises that the focus is often on formal curricula and strategies aimed at altering individual behaviours or promoting mitigation and adaptation efforts; rather than creative and collaborative interventions (Rousell and Cutter-MacKenzie-Knowles 2019; Catanzaro and Collin 2021).

Furthermore, in *Design, When Everybody Designs: An Introduction to Design for Social Innovation* (2015)**,** Manzini advocates for a collaborative and co-design driven approach in design thinking. He emphasises the necessity of interaction between diffuse design (performed by everyone) and expert design (performed by trained designers), to promote meaningful social changes through emerging forms of collaboration (Manzini 2015). Expanding upon this vision, it is important for design education to provide students with appropriate models to help guide and synthesise their insights into creative outcomes that are inclusive, community-oriented and eco-socially responsible.

Embracing the eco-social dimensions and concept of planetary health
The Rockefeller Foundation–Lancet Commission on Planetary Health (Whitmee et al. 2015) defined planetary health as 'the health of human civilisation and the state of the natural systems on which it depends'. The report concluded that while human health – measured by life expectancy and other conventional metrics – has been improving in recent decades, these gains have been unequally distributed, and they have coincided with the degradation of natural systems on a scale never seen in human history.

The report went on to say that continuing degradation of natural systems threatens to reverse health gains achieved over the last century. In short, we are mortgaging the

health of future generations to realise economic and development gains in the present. Anthropogenic global change – including climate change, biodiversity loss, ecosystem disruption and pollution – has direct and indirect health impacts. The consequences for future health are far reaching, ranging from spill over of novel pathogens (such as SARS-CoV-2), food insecurity and malnutrition, to conflict and displacement. Those who are least responsible for driving these changes – poor people in developing countries – are most vulnerable to their consequences.

While these are confronting findings, the Commission concluded with the positive message that humanity can chart a safe, healthy and prosperous course ahead by addressing unacceptable inequities in health and wealth within the environmental limits of the Earth. However, this will require the generation of new knowledge, the implementation of wise policies, decisive action, and inspirational leadership. To respond effectively, societies need to grapple with the global transitions that are currently shaping lives – demographic, epidemiological, food, energy, urban, economic, cultural and ecological. Hence, the need to move beyond human-centred design to design for people and planet.

Planetary health as a framework for cultural transformation
The values and purpose of *Planetary Health: A Framework for Cultural Transformation* (Robba et al. 2020) inspired the development of SEED. As a novel design methodology, SEED provides a mechanism to embrace the interconnectedness between our actions, the health of people and health of planet, by enabling designers and changemakers to better imagine and picture a sustainable future. The core themes outlined in figure 1 define the need to reshape communities' values, culture, mindset, economic systems, regulation, information and crucially, education, to manage ourselves to leave no one behind. This is where design, and design education, must be at the forefront to enhance innovation, resilience and future preparedness. Design, in conjunction with art and science, has a unique ability to enact interdisciplinary thinking and learning focused on sustainability challenges. To change mindsets and behaviours, we must support our students and communities to envision and enact sustainable alternatives to the things we do (the way we live). In planetary health terms – which is defined by the interconnection between the health of people and the health of planet – design thinking needs to address the Five Big Pathways: how we feed the world, move the world, house the world, power the world, and care for the world.
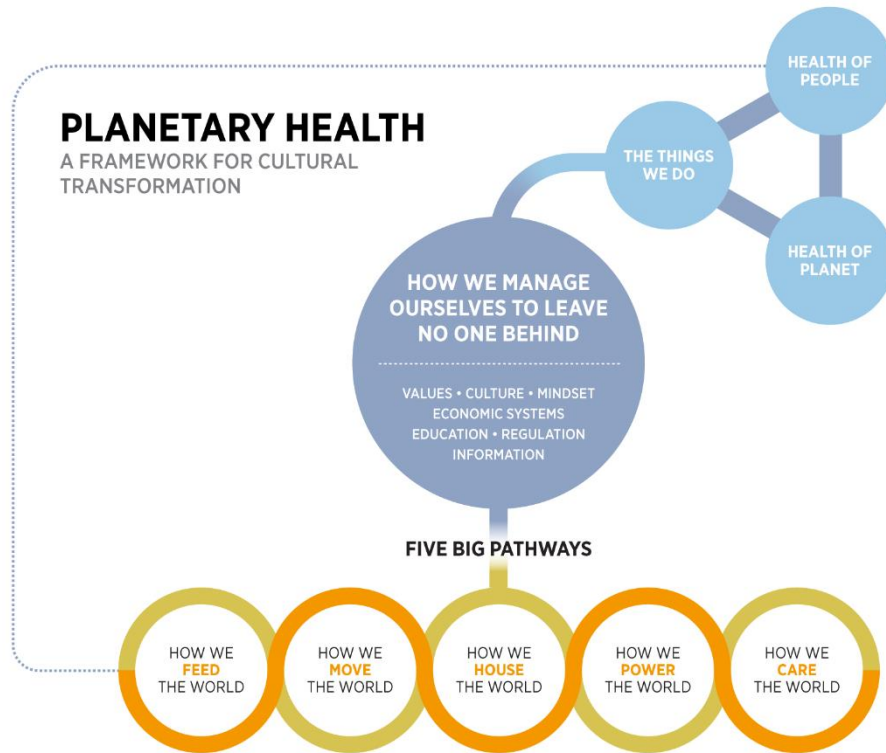
Figure 1: Planetary Health: A Framework for Cultural Transformation. (Robba et al. 2020). Draws a direct connection between human activity (the things we do) with the health of the natural world (our planet) and human health. As a framework, it seeks to illustrate a common language and a shared need for a change in peoples' perspectives through a shift in values, intentions, and behaviours and by linking each person's own health to the health of the planet. Informed by Stephen Boyden's Biosensitivity Triangle (Boyden 2005)

For our students, building eco-literacy combined with a collective reimagining through a reconnection with the natural world is particularly important, as are the objectives for shared values, shared commitments and shared benefits through shared stories (figure 2). Design, art and science in combination are uniquely placed as a knowledge and cultural exchange to express and disseminate complex issues that we face.
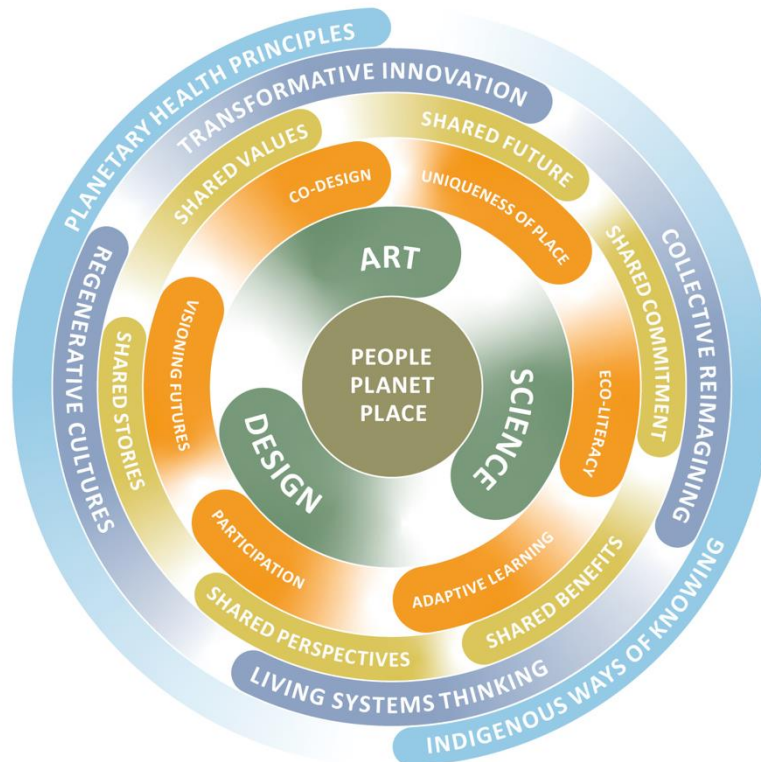
Figure 2: Planetary Health In Action: Nurturing the Well-being of People, Place, and Planet (Robba et al. 2021)

Activism and protest: young people, education, and our shared future

Since 2018, millions of students around the world have taken to the streets calling for urgent action on global warming. Australian young people have led movements like the School Strike 4 Climate with an estimated 500,000 school students participating in coordinated protest around the country (Hilder and Collin 2022). This growing participation supports the evidence that climate change is amongst the top concerns for young people (Collin and McCormack 2020; Collin and Hugman 2020) and demonstrates that they are invested in the future of the planet.

Despite young people's genuine investment in environmental politics, there are concerns that the current approaches to incorporate this into design education are severely lacking. By introducing design methodologies (such as SEED), we have an opportunity to address this by overturning the traditional top-down model of science communication where young people are merely the receivers of information. By embedding children and young people within climate education, we can draw on their experiences to envision climate change education for a better future (Catanzaro and Collin 2023). The SEED methodology addresses the needs of Rousell and Cutter-

MacKenzie-Knowles (2020) findings that claim new approaches should be receptive to radical and visionary alternatives for the future, incorporating elements from environmental activism, social and political engagement, digital innovation, citizen science and the creative arts. By privileging the creative arts and design, we respond to literature that indicates that many young people are deeply political, but in ways that are less conventional, more 'expressive' and 'emotional' (Muxel 2010; Pickard and Bessant 2018).

Further, a bottom-up approach in eco-social design thinking is supported in *Making Things Happen: Social Innovation and Design* (2014), to encourage active participation and collaboration among diverse stakeholders, and directly involve community members as original drivers of change (Manzini 2014). This reinforces our approach for SEED to elevate the perspective of community members – which must include Traditional Owners – as engaged co-creators in the collective reimagining of place.

The shift towards a bottom-up approach necessitates a corresponding transformation and adaptive learning in design education. New approaches such as 'life-centred design' and 'more-than-human design' also invite us to adopt a wider, more inclusive viewpoint, one that is deepened by ecological thinking (Thackara 2006; Wakkary 2021; Tomitsch et al. 2021). Educators and institutions are encouraged to foster curriculum that values and facilitates participatory, collaborative and community-engaged learning. In addition to the development of students' technical skills, design education can adopt integrative models that provide students with clear pathways to empathetically engage with communities, apply diverse and shared perspectives, and co-design with an enhanced understanding and eco-literacy.

Social and Ecological Engagement in Design (SEED): a novel design methodology for change

Our observations and teaching experience led us to reflect upon existing approaches to design thinking, and to develop *Social and Ecological Engagement in Design* (SEED), as an adaptive framework for idea generation, conceptual development and eco-social considerations. SEED's mission is to provide student designers and organisations wishing to enact change with an evolution of traditional design thinking models. SEED aligns with David Orr's vision for a transformative shift in design philosophy, one that 'needs a new kind of design based on an ethical framework in which life is the ultimate source of value' (Owens 2019). Drawing from our

experiences with students, we recognise the limitations of the human-centred design model popularised by IDEO (IDEA 2018). This approach, while significantly influential, is increasingly seen as inadequate for addressing the complex, interconnected challenges of the future (Forlano 2016; Coulton and Lindley 2019; Jones 2022). Orr's call for a 'life-centred design' ethos reflects a critical need for reimagining how we value and interact with the natural world and each other. Specifically, when addressing design briefs, planet and people need to be linked, to enable student designers to engage with the interconnected complexities necessary to effectively shape their creative interventions and process. The SEED methodology has been tailored to guide students with multiple prompts that enhance the idea generation phase, to help them clearly map effective pathways for social and ecological change.

The SEED methodology is structured for designers to involve communities and diverse stakeholders as active participants, as outlined in *Designing for Social Change* (Shea 2012). The detail highlighted in the SEED methodology recognises the importance of a design ethos that builds trust through the understanding that the communities' voice is integral to the design process, which is then embedded in the creative outcome. To identify unique strengths through sustained engagement (Shea 2012), SEED enables designers to harness the power of the emotional connection that people have with their environment, and in particular, where they live. By engaging the emotional connotations and connections to place, SEED seeks to foster a deep, personal commitment to environmental stewardship, cultivating a generation of environmentally conscious and empowered individuals ready to make a difference.

These concepts are embodied in the foundations of designing for change outlined in Papanek's seminal text *Design for The Real World: Human Ecology and Social Change* (1984), where he offers the now understood concept that 'design is basic to all human activities' (Papanek 1984). Further suggesting that the 'planning and patterning of any act towards a desired, foreseeable end constitutes the design process'. His idea that 'any attempt to separate design, to make it a *thing-by-itself*, works counter to the inherent value of design' – and in alignment with planetary health principles – the concept that design ('the things we do') are 'the primary, underlying matrix of life' (Papanek 1984).

Developed to instil a sense of planetary consciousness, hope and agency in the future generation of designers, the SEED methodology provides a structured

approach to empower students (and organisations) to think holistically about societal challenges through creating interventions for sustainable futures. SEED is designed to guide issues-based problem solving and critical thinking, and provide student designers with clarity during conceptual development. As a methodology, it outlines the different interconnecting phases in an ecologically detailed and engaged manner, when compared to traditional human-centred design thinking models. SEED has been adapted to link the social in social design with the ecological imperative underpinned by planetary health principles.
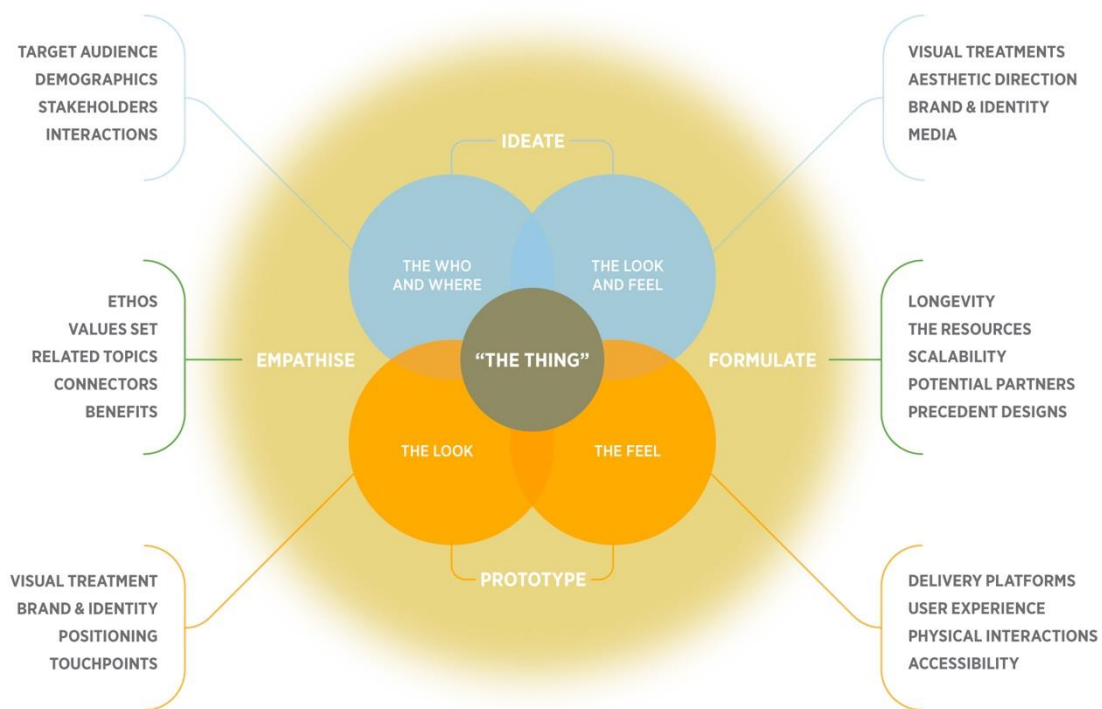

Figure 3: Social and Ecological Engagement in Design (SEED) Methodology. (Robba et al. 2022.)

When applied, SEED aims to enact practical ways to implement internal and external communication for change. As a methodology, SEED recognises that every creative initiative is not a static or fixed solution, but rather a living, dynamic entity within a larger, interconnected ecosystem. The metaphor of a seed has been intentionally applied to encapsulate the principles of interconnectedness and adaptability in sustainable practices. As a seed, these creative interventions require continual nurturing and adaptation for growth – and also reflect the fluid nature of the design process. SEED is a departure from anthropocentric design philosophies that often view problems and envisioned solutions in isolation, with the human firmly positioned at the centre. In alignment with *Post-Anthropocentric Discourses In Design Education* (Tarcan 2023), which explores the lack of post-anthropocentric approaches in

existing design curriculum, SEED challenges the conventional human-centered methods in design thinking, and advocates for more inclusive approaches that consider a broader spectrum of social interactions and ecological implications.

Integrative social and ecologically engaged design

The SEED methodology introduces a structured framework that guides participants through the intricate journey of creation, embedding ethos and value sets, and fostering a deep sense of empathy. The central and targeted component of this process is what we term 'The Thing' – which signifies the core outcome of the creative endeavour (figure 3). This pivotal element is malleable and can evolve as participants navigate through the Empathise, Formulate, Ideate and Prototype stages, engaging with relevant stakeholders, interacting with community members, and exploring related topics to shape and refine their concepts.

For student designers, organisations and design professionals, 'The Thing' represents a realm of boundless creative potential and is open to imagination. In design education, 'The Thing' acknowledges the inherent ambiguity of the creative process and the need to encourage students to explore a breadth of ideas before landing on a fixed solution and to avoid premature visualisation – which may limit innovation (Hargrove and Rice 2015). The openness of 'The Thing' allows designers space to think and reflect upon how they might translate their ideas into tangible outcomes for eco-social impact.

SEED in Action

Through SEED, and design curriculum, we are linking real-world projects via interdisciplinary collaborations conducted in partnership with community and industry. This experiential learning is to provide students with the opportunity to understand the complexities of environmental challenges at a community-level, to work in the field, and be directly involved as part of the co-design process.

The following initiatives are provided as demonstrations of SEED in action.

Blue Mountain City Council's Household Sustainability Toolkit

In the context of the Blue Mountains City Council (BMCC), the design that is currently being developed for a *Household Sustainability Toolkit* (HST) is an example of how SEED can be practically applied within a local government organisation. As the design and different aspects of the HST evolves, in areas of accessibility, scale,

urban planning, interactive platforms, messaging for community, tailored services, and education, the need for a methodology such as SEED to facilitate thoughtful analysis and creative interventions becomes increasingly evident. This is particularly important within complex organisational structures where the exchange of information can often become siloed, hindering internal collaboration and adaptive learning between departments (de Waal et al. 2019).

The key objective of the HST is to enable change in attitudes, values, norms, perceptions and behaviours, via the establishment of communication platforms that encourage community engagement and active participation. Initial precedent analysis and review conducted in partnership with the BMCC has identified the need to build capacity and increase knowledge exchange with residents, by examining social relationships and resource usage of diverse demographics through data collection to reposition and build system-level change.

The Toolkit's design intends to foster an engaging conversation alongside tangible tools that address the technical, environmental and cultural facets inherent to residents living within the UNESCO World Heritage region. The Blue Mountains present unique sustainability challenges and opportunities, and through SEED, the design of a HST is premised to harness the *uniqueness of place*. The design of the SEED methodology has been further informed by work with BMCC and in alignment with their commitment to planetary health and establishment of the *Blue Mountains Planetary Health Initiative* (2023).

Art, science and applied creative practice
The *Painted River Project* (PRP), which has informed the development of the SEED methodology*,* is an art, science and cultural initiative that creates an opportunity for diverse community members to share knowledge and build understanding of how we live with the natural world (Robba and Wright 2019). The PRP aims to nurture transformative thinking and targeted collective action around healthy waterways and river systems. As a place-based initiative, each iteration of the PRP is tailored to different communities and their unique demographics to address site-specific issues related to water health and surrounding ecology.

Examples of the creative interventions that the PRP has implemented to enhance eco-literacy and activate community discussions around the ethos, value sets, relationship to the environment, and the benefits of healthy ecosystems include:

- participatory public painting events in conjunction with mobile science labs that examine live creatures and water health
- primary and secondary school art-science workshops focused on water health and water security
- field study programs where leading Australian artists work alongside community and scientists to creatively respond to site-specific water-based issues, and the hosting of curated exhibitions of their work to activate community conversations through talks, public lectures and symposia.

In each of these public events, the PRP partners with schools, universities, media organisations, local governments and regional galleries to collectively expand the reach of the PRP, and via SEED, raise awareness of water-based environmental issues.

Figure 4: Painted River Project: The Gully (Garguree). Community gathering to listen to Uncle David King's Welcome to Country and to launch the public art, science and design event. 28 May 2023. Photo: Sally Tsoutas.

Figure 5: Art in action, Blue Mountains Community Members painting at The Gully. Photo: Sally Tsoutas.

Figure 6: Science in action: talking water creatures to budding young scientists. Photo: Sally Tsoutas.

After each iteration of the PRP, there is a period of reflection to consider the effectiveness of the various touchpoints, the depth of community engagement and the means of messaging community through various platforms and visual communication.

The science research and engagement component of the PRP incorporates freshwater ecology, water chemistry and water pollution (science and management). Between 2020 and 2023, the PRP ran field studies, public events and exhibitions focused on health of the upland swamps of the Blue Mountains. These fragile ecosystems provide an example of how the health of the planet is suffering due to human activity in the Anthropocene. The upland swamps are endangered wetland and watersheds that have a unique and celebrated biodiversity and are 'protected' by NSW and Commonwealth legislation for their conservation values. The swamps are in a mildly to severely degraded physical and ecological condition. There are many causes that contribute to their degradation, including pollution and erosion resulting from urban development in the Blue Mountains (Belmer et al. 2015, 2018; Carroll et al. 2020). They are also suffering from extreme weather and climate change with the drought, bushfires and heavy rains of 2019–2020 causing damage, erosion and a substantial loss of peat (Carroll et al. 2023). These pressures, informed by science and community concerns, provided an opportunity for the SEED methodology to be practically applied.

To unlock the value of science and better inform community, the sustained engagement undertaken by the PRP helped to raise awareness of the fragility of these swamps. The participatory nature of the PRP also provided a platform to introduce broader discussions to inform our students about how residents, key

stakeholder groups and BMCC might come together to better protect the future of these precious waterways.

Conclusion

We envisage *Social and Ecological Engagement in Design (SEED)* as a novel methodology to enable just transitions from the Anthropocene to the Symbiocene (Albrecht 2020). SEED aims to contribute to the evolution of design education and practice, given the social and ecological challenges facing communities. By embracing planetary health principles and interdisciplinary collaborations, SEED transcends the traditional human design-centred paradigm by emphasising the importance of ethos, values and participatory affect-driven design outcomes that support and enable communities to embrace eco-social change. SEED invites us to rethink our relationship with the environment and our role as designers, educators and community members in shaping a sustainable future. By advocating for a cultural shift towards planetary consciousness, SEED encourages us to envision new narratives and perspectives that instil hope for our students and future generations.

References

ALBRECHT GA (2020) 'Negating Solastalgia: An Emotional Revolution from the Anthropocene to the Symbiocene', *American Imago*, 77:1: 9–30.

ALCÂNTARA E, MARENGO JA, MANTOVANI J, LONDE LR, SAN, RLY, PARK E, LIN YN, WANG J, MENDES T, CUNHA AP, PAMPUCH L, SELUCHI M, SIMÕES S, CUARTAS LA, GONCALVES D, MASSI K, ALVALÁ R, MORAES O, FILHO CS and MENDES R (2023) 'Deadly disasters in southeastern South America: flash floods and landslides of February 2022 in Petrópolis, Rio de Janeiro', *Natural Hazards and Earth System Sciences*, 23:3: 1157–1175, doi:https://doi.org/10.5194/nhess-23-1157-2023.

BELMER N, TIPPLER C and WRIGHT IA (2018) 'Aquatic Ecosystem Degradation of High Conservation Value Upland Swamps, Blue Mountains Australia', *Water, Air, and Soil Pollution*, 229:3, doi:https://doi.org/10.1007/s11270-018-3688-2.

BELMER N, WRIGHT IA and TIPPLER C (2015) 'Urban Geochemical Contamination of High Conservation Value Upland Swamps, Blue Mountains Australia', *Water, Air, and Soil Pollution*, 226:10, doi:https://doi.org/10.1007/s11270-015-2607-z.

BLUE MOUNTAINS CITY COUNCIL (2023) 'Katoomba Master Plan', Blue Mountains City Council, accessed 26 April 2024.

BLUE MOUNTAINS CITY COUNCIL (2023) 'Blue Mountains Planetary Health Initiative', Blue Mountains Planetary Health Initiative website, accessed 26 April 2024.

BOYDEN S (2004) *The Biology of Civilisation: Understanding Human Culture as a Force in Nature*, Sydney: UNSW Press.

BOYDEN S (2005) *People and nature: the big picture*, Canberra: Nature and Science Forum.

CALLAGHAN J (2023) 'The Eastern Australian Floods of February 2022 and Its Relationship with Climate Change', *Journal of Energy and Power Technology*, 5:2: 1–42, doi:https://doi.org/10.21926/jept.2302014.

CARROLL R, REYNOLDS JK and WRIGHT IA (2019) 'Geochemical signature of urbanisation in Blue Mountains Upland Swamps', *Science of The Total Environment*, doi:https://doi.org/10.1016/j.scitotenv.2019.134393.

CARROLL R, WRIGHT I and REYNOLDS JK (2023) 'Loss of soil carbon in a world heritage peatland following a bushfire', *International Journal of Wildland Fire*, 32:7: 1059–1070, doi:https://doi.org/10.1071/wf22204.

CATANZARO M and COLLIN P (2021) 'Kids communicating climate change: learning from the visual language of the SchoolStrike4Climate protests', *Educational Review*, 75:1: 1–24, doi:https://doi.org/10.1080/00131911.2021.1925875.

COULTON P and LINDLEY JG (2019) 'More-Than-Human Centred Design: Considering Other Things', *The Design Journal*, 22:4: 463–481, doi:https://doi.org/10.1080/14606925.2019.1614320.

CUTTER-MACKENZIE A and ROUSELL D (2018) 'Education for what? Shaping the field of climate change education with children and young people as co-researchers', *Children's Geographies*, 17:1: 90–104. doi:https://doi.org/10.1080/14733285.2018.1467556.

DE WAAL A, WEAVER M, DAY T and VAN DER HEIJDEN B (2019) 'Silo-Busting: Overcoming the Greatest Threat to Organizational Performance', *Sustainability*, 11:23: 6860, doi:https://doi.org/10.3390/su11236860.

DUXBURY N, GARRETT-PETTS WF and MACLENNAN D (2015) *Cultural Mapping as Cultural Inquiry*. Routledge.

EVANS G (2015) 'Cultural mapping and planning for sustainable communities', in (eds) MacLennan D, Duxbury N and Garrett-Petts WF, *Cultural mapping as cultural inquiry*, Taylor and Francis.

FORLANO L (2016) 'Decentering the Human in the Design of Collaborative Cities', *Design Issues*, 32:3: 42–54. doi: https://doi.org/10.1162/DESI_a_00398.

HARGROVE R and RICE A (2015) 'The Challenge of Beginning', *International Journal of Art and Design Education*, 34:2: 159–168. doi:https://doi.org/10.1111/jade.12027.

IDEO (2018) '[History](#)', IDEO Design Thinking website, accessed 26 April 2024.

JONES H (2022) 'Beyond human-centred design: Mapping empathy in living systems', in *Metadesigning Designing in the Anthropocene*, Routledge.

LÉGER-GOODES T, MALBOEUF-HURTUBISE C, MASTINE T, GÉNÉREUX M, PARADIS PO and CAMDEN C (2022) 'Eco-anxiety in children: A scoping review of the mental health impacts of the awareness of climate change', *Frontiers in Psychology*, 13, doi:https://doi.org/10.3389/fpsyg.2022.872544.

MANZINI E (2014) 'Making Things Happen: Social Innovation and Design', *Design Issues*, 30:1: 57–66, doi:https://doi.org/10.1162/desi_a_00248.

MANZINI E (2015) *Design, When Everybody Designs: An Introduction to Design for Social Innovation*, MIT Press.

MARSDEN A and KEJRIWAL G (2022) '[For people and planet: moving beyond human-centred design](#)', Nesta website, accessed 26 April 2024.

MEHRABI S, PEREZ-MESA JC and GIAGNOCAVO C (2022) 'The Role of Consumer-Citizens and Connectedness to Nature in the Sustainable Transition to Agroecological Food Systems: The Mediation of Innovative Business Models and a

Multi-Level Perspective', *Agriculture*, 12:2: 203, doi:https://doi.org/10.3390/agriculture12020203.

NANDITHA JS, KUSHWAHA AP, SINGH R, MALIK I, SOLANKI H, CHUPHAL DS, DANGAR S, MAHTO SS, VEGAD U and MISHRA V (2023) 'The Pakistan Flood of August 2022: Causes and Implications', *Earth's Future*, 11:3, doi:https://doi.org/10.1029/2022ef003230.

OWENS J (2019) '10 principles of life centered design', *The Sentient Files*, Medium website, accessed 26 April 2024.

PAPANEK VJ (1984) *Design for the Real World*, Van Nostrand Reinhold Company.

POWER SB and CALLAGHAN J (2016) 'The frequency of major flooding in coastal southeast Australia has significantly increased since the late 19th century', *Journal of Southern Hemisphere Earth Systems Science*, 66:1: 2, doi:https://doi.org/10.1071/es16002.

ROBBA L, CAPON A and LAHOUD M (2020) 'Planetary Health: A Framework for Cultural Transformation', Social Design website, accessed 26 April 2024.

ROBBA L, LAHOUD M and CAPON A (2021) 'Planetary Health In Action: Nurturing the Well-being of People, Place, and Planet', Social Design website, accessed 26 April 2024.

ROBBA L, LAHOUD M and CAPON A (2022) 'Social and Ecological Engagement in Design (SEED) Methodology', accessed 26 April 2024.

ROBBA L and WRIGHT IA (2019) 'The painted river project: Art meets science – communicating cultural transformation through community engagement', *IOP Conference Series: Earth and Environmental Science*, 344, doi:https://doi.org/10.1088/1755-1315/344/1/012015.

ROBBA L, WRIGHT IA, ALLEN J and CAPON AG (2021) 'Urban stream rehabilitation: enabling school children and community to 'visualise' a cleaner and healthier urban stream using art, science and the power of imagination' [conference paper], *Proceedings of the 10th Australian Stream Management Conference, 2–4 August 2021*, Melbourne: River Basin Management Society.

ROUSELL D and CUTTER-MACKENZIE-KNOWLES A (2019) 'A systematic review of climate change education: giving children and young people a 'voice' and a 'hand' in redressing climate change', *Children's Geographies*, 18:2: 1–18, doi:https://doi.org/10.1080/14733285.2019.1614532.

SHEA A (2012) *Designing for social change: strategies for community-based graphic design*, New York: Princeton Architectural Press.

STEFFEN W, CRUTZEN PJ and MCNEILL JR (2007) 'The Anthropocene: Are Humans Now Overwhelming the Great Forces of Nature', *AMBIO: A Journal of the Human Environment*, 36:8: 614–621.

TARCAN B (2023) 'Post-anthropocentric discourses in design education: a wool-centric workshop' [conference paper], *Proceedings of the International Conference on Engineering and Product Design*, doi:https://doi.org/10.35199/EPDE.2023.107.

THACKARA J (2006) *In the Bubble: Designing in a Complex World*, MIT Press.

TOMITSCH M, FREDERICKS J, VO D, FRAWLEY J and FOTH M (2021) 'Non-human Personas. Including Nature in the Participatory Design of Smart Cities', *Interaction Design and Architecture(s)*, 50: 102–130, doi:https://doi.org/10.55612/s-5002-050-007.

WAKKARY R (2021) *Things we could design: For more than human-centered worlds*, MIT press.

WHITE L (9 February 2023) ''Heartbreaking': These neighbours on the same flooded street had different insurance claim outcomes', ABC News website, accessed 26 April 2024.

WHITMEE S, HAINES A, BEYRER C, BOLTZ F, CAPON AG, DE SOUZA DIAS BF, EZEH A, FRUMKIN H, GONG P, HEAD P, HORTON R, MACE GM, MARTEN R, MYERS SS, NISHTAR S, OSOFSKY SA, PATTANAYAK SK, PONGSIRI MJ, ROMANELLI C and SOUCAT A (2015) 'Safeguarding human health in the Anthropocene epoch: report of The Rockefeller Foundation–Lancet Commission on planetary health', *The Lancet*, 386:10007: 1973–2028, doi:https://doi.org/10.1016/s0140-6736(15)60901-1.