Exploring dynamic processes within the ecological university: a focus on the adaptive cycle

Ian M. Kinchin

Surrey Institute of Education, University of Surrey, Guildford, UK

ABSTRACT
The university-as-ecosystem concept provides a framework for the analysis of the dynamic maintenance of sustainable pedagogies within the university. Application of Holling’s adaptive cycle, used to describe the active constructive and destructive processes of stabilisation and destabilisation within an ecosystem, is explored here in the context of the ecological university. The cycle predicts that disruptions to the system initiate a period of reorganisation. The concept of nested cycles (a panarchy) is explored in the higher education teaching environment here for the first time. Crucially, this shows how adaptive cycles within ecosystems occur at different scales of time and space that might align with different levels within the university – the individual, the department/discipline, and the institution. These levels need to be in communication with each other in order to develop in ways that are complementary and mutually supportive. As decisions about teaching are made with a mixture of objective, evidence-based reasoning alongside more subjective and affective thinking, a degree of epistemological pluralism is required to support the development of post-abyssal thinking to promote consilience across the ecology of knowledges. The potential of an epistemologically plural ecological lens is discussed in the context of university teaching.

KEYWORDS
Consilience; ecosystem; epistemological pluralism; Holling: panarchy; pedagogy

Introduction

There is currently a move within the research literature away from reductive, linear assumptions that have driven the dominant higher education narratives along a confused neoliberal agenda (Kinchin & Gravett, 2022), towards a less linear mode of thought that adopts an ecological perspective. Within this context, this paper contributes to the evolving concept of the ecological university by focusing on processes that maintain complex socio-ecological systems. Many studies in the contemporary higher education research literature claim to have adopted ‘an ecological approach’ within their methods, notably in the areas of feedback and assessment (e.g. Chong, 2021; Gomez et al., 2013) and the development of teacher agency (e.g. Leijen et al., 2020; Priestley et al., 2015); while Ellaway et al. (2017) have considered that the application of ecological theories can afford opportunities for a more systematic response to contextual change

CONTACT Ian M. Kinchin i.kinchin@surrey.ac.uk Surrey Institute of Education, University of Surrey, Guildford, GU2 7XH, UK

© 2021 The Author(s). Published by Informa UK Limited, trading as Taylor & Francis Group. This is an Open Access article distributed under the terms of the Creative Commons Attribution License (http://creativecommons.org/licenses/by/4.0/), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.
by increasing the university’s adaptive capacity. However, there seems to be little consensus about what an ecological approach means in practice beyond considering how the active links between numerous connected concepts impinge on the subject of study. Some authors have considered the essential elements of an ecological stance to be associated with ‘bottom-up’ approaches that offer a counter to the dominant (top-down) neoliberal arguments that dominate the policy discourse (e.g. Charteris, 2016). While this line of argument is understandable, the replacement of one linear trajectory (top-down) with another (bottom-up) may offer too simplistic a description of the context to account for the complexity of the ‘messy assemblage of networks, superstructures and flows’ within teaching (Mooney Simmie et al., 2019).

The growing acknowledgement of the interconnectedness of complex systems (the ecological approach) needs to be aligned with ecological ways of thinking (i.e. systems thinking). Capra (2005, pp. 20–21) has identified a number of shifts in perception that are needed to accompany the adoption of ecological thinking. These are summarised as shifts from the parts to the whole; from objects to relationships; from objective knowledge to contextual knowledge; from quantity to quality; from measurement to mapping; from structures to process, and from contents to patterns. Such systems thinking is not best served by a singular epistemology that limits our vision. The development of non-linear (rhizomatic) ways of thinking owes much to the poststructuralist literature (e.g. Deleuze & Guattari, 1987). This offers a challenge to the typical fragmentation of the academic literature (Bohm, 1980), and the associated monoculture of mind (Shiva, 1998), and requires the reader to consider concepts and language that lie outside the normal academic silos of disciplinary discourses (Kinchin & Gravett, 2022). Bringing the scientific literature that has examined the processes that maintain biological ecosystems into the same discussion as the complementary post-structural perspective of rhizomatic thought requires a level of post-abyssal thinking (sensu Santos, 2014) in which the epistemological sovereignty of science is relinquished to allow the voices of other groups to be heard. Post-abyssal thinking can thus be summarised as learning from the ‘other’ side [of the abyssal line] through parallel epistemologies of, for example, the posthumanists. It confronts the monoculture of modern science with the rich ecology of knowledges (Santos, 2014). Such epistemological pluralism is seen as the way forward for interdisciplinary research (e.g. Andreotti et al., 2011; McGonigle, 2017; Suri, 2013) – including that which investigates the processes that maintain complex socio-ecological systems where plurality can lead to a more successful and integrated study (Miller et al., 2008). As a precedent for such boundary crossing, it is helpful here to introduce the idea of consilience, as developed by celebrated ecologist, E.O. Wilson (1998), who argued that the crippling compartmentalisation of the disciplines within the university creates a barrier to intellectual progress, and that the ‘great branches of learning’ should be brought together so that the social sciences and humanities would benefit from an alliance with the natural sciences. Consilience literally means ‘jumping together’ and has been used to describe the idea that evidence from independent and unrelated sources can converge on strong conclusions. The concept of consilience has been utilised recently in educational research by Duncan and Sankey (2019) to counter the dichotomous thinking that can steer policy and pedagogy in different directions in their attempt to unify conflicting visions of education, and by Van Vugt and Von Rueden (2020) to accommodate the plurality of theoretical and methodological approaches within a comprehensive synthesis of
evolutionary approaches to leadership. Therefore, in examining the role of the adaptive cycle from complementary scientific and philosophical perspectives, this paper attempts a structuralist-poststructuralist consilience of the ecological university. The links between the main concepts discussed here are summarised in Figure 1.

**Natural history of the university**

In order to initiate the development towards an ecological university – seductively described by Barnett (2017) as ‘a feasible utopia’ – we need to have detailed knowledge of the diversity inhabiting the ecosystem in terms of disciplinary views, teaching styles, strengths, assets and motivations etc. The health of an ecosystem is based on its biodiversity, and so development towards an ecosystemic perspective of the university should not seek to reduce diversity, but to understand it. That is to say, a detailed ‘natural history’ is needed of the institution. As we are considering a social system here (the university), the natural history is composed of more than the biological components, and will consist of an interwoven assemblage of political, cultural and personal elements.

Before delving into the potential of an ecological perspective on teaching within the university, we first need to consider the pre-cursor to ecology, natural history, and how the relationship between natural history and ecology can inform the development of the ecological university. Support for this is offered by Anderson (2017) whose insightful commentary provides a scaffold for our thinking about the ecological university. So that when Anderson comments: ‘The two fields’ intertwined histories show that most theoretical breakthroughs are preceded by the kind of deep observational work that has fallen out of vogue’ (p. 290), we can visualise a similar pattern of research in biological
ecosystems and in university ecosystems. Observational studies provide the baseline for
the subsequent development of theory, and ‘the process of broadly based, patient
observation must be valued as an essential first step in the scientific method’ (p. 291),
however unfashionable such studies may be today. The ecological validity of educational
research depends on the observation of teaching in classrooms where variables are not
easily controlled. Studying how students (or teachers) react to certain interventions within
controlled settings may provide interesting data, for example, to inform the analysis of
a question in a doctoral study, but this may not provide useful information for practi-
tioners working in authentic and messy environments. The reporting needs of researchers
often drive research towards greater control of their subjects and the sanitisation of data.
Considering ecology students, Anderson writes:

students are encouraged to spend more time indoors, conducting lab ‘experiments’ with
predetermined outcomes and running increasingly sophisticated simulations of behaviours
rather than observing actual organisms in an uncontrolled context (p. 291)

In his 1927 book on animal ecology, Charles Elton - arguably one of the most influential
British ecologists of the 20th century - casts back to the natural historians of the 18th
century by quoting Gilbert White’s 1789 book, The Natural History of Selborne, in which
White criticized the sort of research that ‘a man might do in his study,’ saying: ‘The
investigation of the life and conservation of animals is a concern of much more trouble
and difficulty, and is not to be attained but by the active and inquisitive.’ Elton then says,
‘Ecology is a new name for a very old subject. It simply means scientific natural history.’
(p. 294)

The resource that researchers often lack the most is time: ‘time to think, time to study, and
time to observe, unencumbered by any demand to “publish or perish”’(p. 295). The
tendency is then to skip the detailed description of the environment (the natural history)
and move prematurely to the testing of hypotheses. Recent work has attempted to
undertake deep observational work within a single university (e.g. Gravett et al., 2020;
Kinchin et al., 2021; Kinchin & Winstone, 2018; Lygo-Baker et al., 2019) to model the raw
materials for the construction of a dynamic, institutional natural history. This work raises
a diversity of voices for consideration that have not been gained by using the dominant
methods for generating an evidence base that are seen by some observers to promote
monocultures of practice (Bennett, 2015; Malone & Hogan, 2020; Shahjahan, 2011).
Rather, it explores voices that have emerged during extended engagement in various
SoTL-type [Scholarship of Teaching and Learning] scholarly projects during which per-
spectives have had time to mature and the independent agendas of the participants have
had time to materialise. Underpinning this natural history approach is a philosophy
focused on the mapping of ethical pathways for forming relationships across the uni-
versity community, based on trust, respect, consent and accountability, rather than
extraction and appropriation (as discussed by Andreotti, 2021). These narratives can
then be viewed as nomadic elements, using the principles of cartography, which:

implies that we can compare narrative selfhood with a dynamic map of narrations (and not
with a tracing of reality), a map that is always open and always changing. The narrations
someone tells about herself or himself are never complete; they form an ongoing process of
co-construction and co-reconstruction. As a researcher, one can thus never have a view on
the complete map of one’s participant, seeing that this map is co-constructed, multiple, and constantly changing. We can only explore several temporal regions and paths knowing that we are taking part in the exploration. (Sermijn et al., 2008, p. 644)

It is also evident that higher education discourses have an emphasis on quantitative data to define the measured university (Manathunga et al., 2017; Sellar, 2015). However, Anderson’s words about ecology are quite prophetic in the HE context, where we have come to rely on ‘an increased emphasis on statistical manipulation and technology . . . but it is not clear that an ever-improving ability to measure has translated into better guidelines of what matters in terms of what should be measured, or, subsequently, in our ability to predict outcomes’ (p. 295). Not everything that is significant in education is amenable to measurement.

**Ecological analogies in education**

There has been a long-standing tendency to draw upon ecological analogies within education research that help to articulate the complex relations that are seen to occur within classrooms and, more widely, across whole institutions (Kinchin, 2016; Svenkerud et al., 2020). The attraction fuelling this tendency was summarised by Toulmin (1972, p. 316), who stated:

What makes it worthwhile to extend ecological terminology from organic to intellectual evolution is, simply, the extensive parallels between the ecological account of organic change and the disciplinary account of intellectual development.

Building on this, Watson (1986, p. 85) suggested that by extending the ecological metaphor it is possible to evoke and describe a level of connectedness between biological and conceptual ecosystems that goes beyond simple comparison. Using the ‘teaching with analogies’ model developed by Glynn (1991), features of the analogue concept (biological ecosystems) can be mapped against corresponding features of the target concept (conceptual ecosystems) – see Table 1.

An ecological perspective recognises the interconnected nature of concepts and the importance afforded to those connections (e.g. Guattari, 2014). However, holistic repurposing of ecological concepts into the educational research literature (rather than mere appropriation of the term) requires an appreciation that ecology is part of the wider

| BIological | Conceptual |
|------------|------------|
| Species interactions | Concept interactions |
| Ecological succession | Conceptual change |
| Open system | Open system |
| Display connectedness | Display connectedness |
| Vary in complexity | Vary in complexity |
| No two are identical | No two are identical |
| Respond to perturbations (stability and resilience) | Respond to perturbations (stability and resilience) |
| Keystone species | Keystone concepts |
| Limited by gene pool | Limited by prior knowledge |
| Made intelligible through graphic simplification (food webs) | Made intelligible through graphic simplification (e.g. concept maps or social networks) |

(after Kinchin, 2000)
assemblage of biology – itself an interconnected web of complex concepts that are all related to each other by the unifying (threshold) concept of evolution (Dobzhansky, 1973). And so, reference to ecology cannot be conceptually disentangled from the rest of biology (particularly from evolution) if the concept label is to retain any deep understanding of the field. The key position of evolution is emphasised by Allee et al. (1949, p. v) in their influential definition of ecology:

By ecology we mean the body of knowledge concerning the economy of nature—the investigation of the total relations of the animal both to the inorganic and to its organic environment; including, above all, its friendly and inimical relations with those animals and plants with which it comes directly or indirectly into contact—in a word, ecology is the study of all those complex interrelations referred to by Darwin as the conditions of the struggle for existence.

The term ‘ecology’ was coined in 1869 by Ernst Haeckel from the Greek word Oikos meaning ‘household’ and logos meaning ‘study of’, therefore the ‘study of nature’s household’ (Egerton, 2013). However, defining ecology was only part of Haeckel’s larger objective of ‘Darwinizing our understanding of nature’ (Watts et al., 2019). Ecology was borne of a desire to explain the evolutionary process. The entanglement of ecology with evolution should not be seen as constraining thinking in any way. While the definitions of ecology have evolved over the years, so too has the description of the evolutionary process with the trend towards an increasingly pluralistic evolutionary worldview (Araujo, 2020). As Deleuze and Guattari (1987, p. 249) have put it when referring to multiplicities such as ecology, ‘it is not divisible, it cannot lose or gain a dimension without changing its nature’. Therefore, to ‘use’ ecology in isolation from evolution would be to lose its nature and make the term meaningless. Successful repurposing of the concept (i.e. exaptation sensu Gould, 1991), therefore, requires a degree of ecological literacy on the part of the user, requiring development beyond novel description using colourful metaphors because, ‘real ecological literacy is radicalizing in that it forces us to reckon with the roots of our ailments, not just with their symptoms’ (Orr, 1992, p. 88). An ecological perspective is, therefore, not about simplification:

Ecological thinking is now genuinely ecological not because it accounts for the biological or economic interrelations in an ecosystem, but because it understands the term ‘ecological’ as the indissoluble systemic union of these with the social, cultural and mental. In short, the foundation of the real ceases to be simplicity and becomes complexity. (Molina-Motos, 2019, p. 5)

Within biology, the appreciation of genetic variation as the engine of change has been considered a threshold concept in the understanding of evolution (e.g. Walk-Shannon et al., 2019) – consequently influencing the understanding of ecology. The concept of variation may also have a similar role in the development of teaching in the ecological university. Whereas more linear and restrictive thematic analyses of teachers and teaching will tend to emphasise ‘sameness’ or uniformity in a population (e.g. Mazzei, 2016), the acknowledgement of the central role of variation (and the need to foster it in a healthy teaching ecosystem) requires a more rhizomatic analysis of difference (Bozalek & Zembylas, 2017; Deleuze & Guattari, 1987). Within the messy assemblage of teaching (e.g. Bacevic, 2019; Mooney Simnie et al., 2019), this exhibition of difference is exemplified by the ecological analysis of the variation evident in
academic narratives (as explored by Gabriel, 2016) and its potential to contribute to pedagogic frailty (Kinchin & Winstone, 2018). This foregrounding of difference may form the basis of an ecological literacy of teachers and teaching that could in turn support an appreciation of the ecological university. In addition, as another overlap between the ecological and the conceptual, an appreciation of the central notion of ‘transformation’ in ecological processes (see Carlsson, 2002) parallels the idea of transformation in knowledge structure as a threshold concept in teaching (e.g. Kinchin & Miller, 2012).

**Ecosystems**

The idea of the ecological university developed by Barnett (2011, 2017) is centred around the idea of seven ecosystems that he recognises within the university:

1. The knowledge ecology
2. The ecology of social institutions
3. Persons
4. The economy
5. Learning
6. Culture
7. The natural environment

This list should be regarded as provisional, representing a mixture of physical spaces (e.g. the environment) and conceptual/process-based ideas (e.g. culture). The behaviour of these ecosystems requires further investigation to see how they function in different contexts, and crucially, how they interrelate. Golley (1993, p. 205) considers the concept of ecosystem to have a bridging role that ‘has provided a basis for moving beyond strictly scientific questions to deeper questions of how humans should live with each other and the environment’. To develop the ecological university concept further, it is sensible to clarify what we mean by ecosystem if it is to form the centre piece of our thinking. In order to achieve this, we first need to be sure if we are searching for a realist definition that claims to make a statement about ‘reality’ or ‘truth’, or a nominal definition that functions as an abbreviation for a complex statement (Jax, 2007). The idea of a universal truth would be a difficult idea to sell within the contested landscape of the university and so we are looking at a nominal definition. In addition, I would argue that in the context of the university we are considering ‘ecosystem’ as a perspective that offers a way to deal with a problem or a cipher for holistic thinking, rather than as an object that is realised in space and time, in which case, as it is argued by Jax (2007), ‘An ecosystem concept that serves as an organizing scheme should even be rather vague and conceptually open to stimulate research and concept development’. This ensures that scholarship is not closed down prematurely once a definition of the concept has been agreed – as every definition is a covert theory (D’Andrade, 1984). It maintains the need for further reflective critique and active engagement in the discourse. This has been explored in terms of the notion of the travelling concept:
While groping to define ... what a particular concept may mean, we gain insight into what it can do. It is in the groping that the valuable work lies. The groping is a collective endeavour. Even those concepts that are tenuously established, suspended between questioning and certainty, hovering between ordinary word and theoretical tool, constitute the backbone of the interdisciplinary study of culture – primarily because of their potential intersubjectivity. Not because they mean the same thing for everyone, but because they don’t.. (Bal, 2002, p. 11)

In addition, Holling (2001) argues that the complexity of socio-ecological systems emerges not from a random association of a large number of interacting factors, but rather from a smaller number of controlling processes. This provides another avenue for the enhancement of the ecological university model – the focus on underlying processes that regulate ecosystem function. To that end, in this paper I focus on the application of the adaptive cycle that is seen by Miller et al. (2008) as an analogy for the ways in which education may be conducted, using the four phases of the cycle to describe the processes of knowledge production.

The adaptive cycle

Within the viewpoint of the ecological university, a useful metaphor for change is provided by the adaptive cycle (Holling, 2001), that represents the stabilising and destabilising processes that maintain ecosystem health. The Holling ‘lazy-eight’ adaptive cycle model (Figure 2) is a powerful and useful metaphor of system dynamics that includes a sequence of four stages: growth (r), conservation (K), release (Ω), and reorganisation (α). The α phase is a relatively rapid period of assembly of system components that occurs after a disturbance to the system and is an opportunity for novel recombination. It is this phase in the recombination of the university ecosystem where efforts made to innovate are likely to have most impact. In contrast, the K phase is a relatively slow-moving phase of consolidation and accumulation of material that occurs during moments of relative environmental stability. During this phase, practices and habits within the university ecosystem will become re-established and change will be more difficult to initiate. Overall, the cycle heuristic provides a fundamental unit of study that contributes to the understanding of the dynamics of complex systems (Sundstrom & Allen, 2019).

The test of a system is its performance in the release stage (Ω), as it is here that the capacity for a system to survive an extreme disturbance is tested – such as the experience of universities during the Covid-19 pandemic. A system must maintain vital functions throughout a crisis. In human organisations such as universities, it is often up to leadership, both assigned and assumed, to identify and prioritise what that means (Fath et al., 2015). It is evident that during the Covid-19 crisis many of the vital teaching functions of universities have been maintained, but in the extraordinary context of the pandemic many teachers may have been forced to consider a new set of orienting priorities (Murray et al., 2020), and make decisions that were inconsistent with their espoused beliefs about teaching and learning (e.g. Sansom, 2020). In the short term we are all likely to have to endure periods of tension where we have to ‘make-do’ with what we have available. However, in the long term this is not sustainable, and we need to plan ahead so that university pedagogy emerges from the pandemic in a new improved and more sustainable form (e.g. Sandri, 2020). In short, ‘It is a time for academic leaders courageous enough
to disrupt longstanding patterns of behaviour, to challenge opinions and organizational norms, and disrupt the status quo’ (Fernandez & Shaw, 2020, p. 41). This is not just through challenging ‘the system’ but by revising the ways in which we work and conceptualise our relationships with others. In practical terms this means that academic leaders need to provide conceptual frameworks for sense-making. Kinder et al. (2021) describe this as building an overall collective consciousness by creating and encouraging relationships founded on learning from the logic-of-practice. The ecological models presented here can be infused into current practices by aligning their use to established activities (such as the peer observation of teaching) to help colleagues locate themselves within the adaptive cycle. Within an ecological perspective, order comes from the actions of interdependent agents who exchange information (Branson, 2010) rather than dependence upon central control. Nicholson and Kurucz (2019) propose that we should replace the fundamental assumption about effective leadership as an individual pursuit with the relational assumption of growth-in-connection, and in so doing take the ‘heroic’ leader, that has dominated Western culture, out of leadership (Clifton, 2017).

**Panarchy**

When considering the structure of complex educational practices, Kemmis et al. (2012, p. 41) have discussed connections between elements and how ‘nesting’ is evident across functions such as leadership, professional development, teaching and learning. These are linked as a chain in which:
This chain does not operate in a one-way direction, however. There are also feedback loops from each to the others and not just back from learning at ‘the bottom’ to leadership ‘at the top’. Indeed, it is not at all clear which direction – or whether there is a single direction – in which these practices relate to one another, despite conventional presuppositions of hierarchy about leaders and those they are said to lead, between professional developers and those they are said to develop, and between teachers and those they are said to teach.

In ecosystemic terms, a nesting set of cycles operating at discrete ranges of scale is described as a panarchy (Gunderson & Holling, 2002) (Figure 3). Panarchy theory is a systems-thinking adaptation of ecological and complexity theories that is used to explain and explore the process of adaptation and change within ecological or sociological systems. Contrary to the notion that there is a simple equilibrium for systems to achieve that allows them to occupy a state of rest (see Briske et al., 2017), panarchy acknowledges the complexity of dynamic states of equilibria for ecological, societal, and economic systems (Gunderson & Holling, 2002). Panarchy theory is useful because it provides a succinct and descriptive model for describing all systems using ecological characteristics. What makes it particularly unique in the world of sociological research is that it can be used in human systems providing descriptions of how humans move and adapt through multiple equilibria of thought, expression, and behaviour at individual and

Figure 3. A series of nested adaptive cycles forming a panarchy to describe the university ecosystem. A = an individual academic, B = a school/department, C = the entire institution. (Redrawn and based on C.R. Allen et al., 2014).
societal levels (e.g. Varey, 2011). The theory suggests that human society, even in this time of human-induced ecological crises, exhibits ecological resilience (sensu Holling, 1996), such that humans are implicitly adaptive, often at the expense of the very systems that have sustained them.

Although ecological panarchy was originally derived from the empirical investigation of the biological aspects of ecologies (e.g. Allen et al., 2014), the theory has been extended to incorporate dynamics that are primarily sociological (Varey, 2011). It is applied to the concept of the ecological university for the first time here. Recognising the suitability of panarchy theory as a heuristic of complex systems organisation, many authors have investigated the linkages between adaptive cycles in social systems and ecosystems focusing on cycles of destruction and renewal. Panarchy is different from typically envisioned hierarchies in that control is not just exerted by larger-scale, top-down processes, but can also come from small-scale or bottom-up processes. Additionally, the dynamics of renewal and collapse within-scale domains within adaptive cycles differ from the more static view of traditional hierarchy theory. Because of the potential for cycling within adaptive cycles to affect both smaller scales and larger scales, panarchy theory emphasises cross-scale linkages whereby processes at one scale affect those at other scales to influence the overall dynamics of the system (Allen et al. 2014).

It is unlikely that adaptive cycles across a university panarchy will be synchronised. Major disturbances (such as Covid-19) will be experienced in personal and idiosyncratic ways across the university. For example, those colleagues who were already routinely teaching online will have found the emergency ‘forced migration’ to the online medium easy to accommodate within their practice. Other colleagues whose teaching is traditionally face to face, particularly where the teaching is a whole-body experience (e.g. acting, singing or dancing) will have found the transition to social distancing much more of a challenge. As far as the students are concerned, the increased focus of online teaching will have increased the inequalities on either side of the digital divide, with students who cannot afford powerful laptops or fast broadband connections struggling to access teaching materials. This represents highly personalised details regarding those who populate the adaptive cycles (individuals within the university). In addition, there will be other minor disturbances affecting cycles at different levels; for example, the individual academic who has to cope with a poor teaching evaluation from a class (level A, Figure 3); the new Head of Department who wants to reorganise the teaching activities within a team (level B, Figure 3), or the senior management team who decide to introduce a new marking policy for student coursework across the institution (level C, Figure 3). The university panarchy offers a predictive framework to support the ecological leadership of university teaching (Allen et al., 1999), that increases the visibility of elements within the system whilst acknowledging its complexity. It is crucial that the lines of communication between the different levels (Figure 3) are open to receive information and are active in both directions to ensure that the different levels do not develop in antagonistic ways, where policy is out of sync with practice. This can result in pedagogic frailty across the system (Kinchin & Winstone, 2017) when tensions that are needed to maintain a healthy and dynamic state become unproductive.
Conclusion

As a recent example of a major ecological shock, the Covid-19 pandemic of 2020–21 forced rapid change upon society and upon our universities. It has increased the rate of change of several social transformations that were already underway. The migration to online shopping and the death of cash has been observed to change many of our daily habits. While in universities, we have witnessed the wholesale migration of teaching to online platforms, along with all the implications that brings (e.g. Watermeyer et al., 2021). The ways in which we choose to respond to this shock will define our universities for the next decade. Therefore, it is crucial that the response is considered, theoretically informed and evidence based. However, Roth (2018) cautions us about the politics of evidence and to reconsider pervasive ‘conceptions of teachers and students as ratiocinating, self-interested individuals to a conception of them as social persons caught up in events that exceed their grasp and control’. In other words, the reductionist visions promoted by instrumental reason may not account for the parallel epistemologies employed by teachers and students, so they do not appear to react in rational and predictable ways to the evidence provided – evidence they see as divorced from everyday experience. This is why practices can persist even when they contradict the available evidence (see Chambers, 2003).

To regard Covid-19 as a one-off, short-term blip in the way we work before returning to the status quo would be a naïve position (Andreotti, 2021). The scientific evidence is clear that the Covid-19 pandemic is unlikely to be a unique occurrence (e.g. Morens & Fauci, 2020). In addition, the disruption caused by the pandemic is likely to be exacerbated by continuing political and economic uncertainties – such as that caused by Brexit in the UK. And so, we need to develop a long-term plan for a sustainable pedagogy for an uncertain future. Within the teaching ecology, a number of other concepts play crucial roles and these may need to be reconceptualised for the ecological university. For example, the idea of care needs to be separated from the neoliberal ‘politics of repair’ and seen as a dynamic ‘ecology of support’ (Duclos & Criado, 2019). While the centrality of care in teaching is well-established in the research literature (e.g. Noddings, 2012), the Covid-19 pandemic has brought this to the forefront of our consciousness. Care is a complex concept and one that needs to be clearly articulated in the ways in which it relates to other key ideas within our teaching context – particularly pedagogy. For this fit to work, care has to be aligned to ideas of wellbeing and resilience (Kinchin, 2019; 2020; Kinchin et al., 2021). The wellbeing of staff and students is paramount. Therefore, we need to adopt a ‘salutogenic’ response (Antonovsky, 1987), building on assets, rather than adopting a pathological response that will leave us chasing our tails in search of short-term fixes for the problème du jour. This requires that we build a sense of coherence across the panarchy as a component of our pedagogy of care (Kinchin, 2019). Similarly, the development of resilience is often seen as a characteristic of ecosystems (e.g. Fath et al., 2015), and is seen as a way forward to help navigate uncertainties ahead. But we need to be clear what we mean by this as it is a contested concept that is taken to mean different things in different contexts (e.g. Brewer et al., 2019). Within an ecological perspective, the meaning of resilience is clear. Holling (1996) defines ecological resilience in terms of persistence, adaptiveness, variability and unpredictability. This is in contrast to engineering resilience,
a managerial perspective that focuses on efficiency, control, constancy and predictability. These latter characteristics are often summarised unhelpfully as ‘grit’ (see Gorski, 2016), and are at odds with the environment in which we live. Engineering resilience is likely to promote pedagogic frailty (Kinchin & Winstone, 2017), where unproductive tensions across the levels of the panarchy inhibit innovation.

To turn the theoretical idea of the ecological university into a practical reality, we need to increase the level of understanding of the dynamic processes that maintain ecosystem health (Orr, 1992), and the critical role of (bio-)diversity in this. The panarchy perspective helps to appreciate the complexity of the ecosystem, and by considering a relatively small number of processes it makes the endeavour more manageable. In practice, the operationalisation of the ecological university requires simultaneous interventions across the panarchy and might include the application of the adaptive cycle to staff development (as a heuristic to support critical reflection) as well as a framework for strategic development – details will be offered in a subsequent paper. The illusion of long-term stability (Schön, 1971) is laid bare by this model that shows how periods of stability will be localised and transient within certain levels of the panarchy (the conservation phase [K] of the adaptive cycle), and that a non-equilibrium model of the ecosystem (Briske et al., 2017) explains why ‘becoming’ rather than ‘being’ (Deleuze & Guattari, 1987) is the dominant condition. For pedagogies to be sustainable (i.e. to persist through an entire turn of the adaptive cycle) they will need to exhibit ecological resilience (Holling, 1996), and provide ecologies of support (Duclos & Criado, 2019) to those involved by recognising contextual diversity. They will need to reflect the parallel epistemologies (scientific and non-scientific) that are evident within the institutional natural history and will require coherence across the panarchy by building a collective consciousness to accommodate the ecology of knowledges (Santos, 2014) and the ecology of practices (Kemmis et al., 2012) that populate the university environment. Covid-19 has provided a stark case study of the effects of a major disturbance on the university ecosystem and illustrates the potential value of an ecological approach to university dynamics – suggesting that an aspiration to ‘return to normal’ is a naive managerial stance.

Disclosure statement
No potential conflict of interest was reported by the authors.

Notes on contributor
Ian M. Kinchin is Professor of Higher Education within Surrey Institute of Education, University of Surrey, Guildford, UK. He is engaged in the professional development of university teachers.

ORCID
Ian M. Kinchin http://orcid.org/0000-0001-5425-4688
References

Allee, W. C., Emerson, A. E., Park, O., Park, T., & Schmidt, K. P. (1949). *Principles of animal ecology*. W.B. Saunders.

Allen, C. R., Angeler, D. G., Garmestani, A. S., Gunderson, L. H., & Holling, C. S. (2014). Panarchy: Theory and application. *Ecosystems*, 17(4), 578–589. https://doi.org/10.1007/s10021-013-9744-2

Allen, K. E., Stelzner, S. P., & Wielkiewicz, R. M. (1999). The ecology of leadership: Adapting to the challenges of a changing world. *Journal of Leadership Studies*, 5(2), 62–82. https://doi.org/10.1177/107179199900500207

Anderson, J. G. T. (2017). Why ecology needs natural history. *American Scientist*, 105(5), 290–297. https://doi.org/10.1511/2017.105.5.290

Andreotti, V. D. O. (2021). The task of education as we confront the potential for social and ecological collapse. *Ethics and Education*, 16(2), 143–158. https://doi.org/10.1080/17449642.2021.1896632

Andreotti, V. D. O., Ahenakew, C., & Cooper, G. (2011). Epistemological pluralism: Ethical and pedagogical challenges in higher education. *AlterNative: An International Journal of Indigenous Peoples*, 7(1), 40–50. https://doi.org/10.1177/117718011100700104

Antonovsky, A. (1987). *Unravelling the mystery of health: How people manage stress and stay well*. Jossey Bass.

Araujo, L. A. L. (2020). The centrality of evolution in biology teaching: Towards a pluralistic perspective. *Journal of Biological Education*, 1–12. https://doi.org/10.1080/00219266.2020.1757486

Bacevic, J. (2019). With or without U? Assemblage theory and (de)territorialising the university. *Globalisation, Societies and Education*, 17(1), 78–91. https://doi.org/10.1080/14767724.2018.1498323

Bal, M. (2002). *Travelling concepts in the humanities: A rough guide*. University of Toronto Press.

Barnett, R. (2011). The coming of the ecological university. *Oxford Review of Education*, 37(4), 439–455. https://doi.org/10.1080/03054985.2011.595550

Barnett, R. (2017). *The ecological university: A feasible utopia*. Routledge.

Bennett, K. (2015). Towards an epistemological monoculture: Mechanisms of epistemicide in European research publication. In D. Britain & C. Thurlow (Eds.), *English as a scientific and research language* (pp. 9–36). Walter de Gruyter Inc.

Bohm, D. (1980). *Wholeness and the implicate order*. Routledge.

Bozalek, V., & Zembylas, M. (2017). Diffraction or reflection? Sketching the contours of two methodologies in educational research. *International Journal of Qualitative Studies in Education*, 30(2), 111–127. https://doi.org/10.1080/09518398.2016.1201166

Branson, C. M. (2010). Free to become: The essence of learning and leading. In A. H. Normore (Ed.), *Global perspectives on educational leadership reform: The development and preparation of leaders of learning and learners of leadership* (pp. 85–104). Emerald Group Publishing Ltd.

Brewer, M. L., van Kessel, G., Sanderson, B., Naumann, F., Lane, M., Reubenson, A., & Carter, A. (2019). Resilience in higher education students: A scoping review. *Higher Education Research & Development*, 38(6), 1105–1120. https://doi.org/10.1080/07294360.2019.1626810

Briske, D. D., Illius, A. W., & Andries, J. M. (2017). Nonequilibrium ecology and resilience theory. In D. D. Briske (Ed.), *Rangeland systems: Processes, management and challenges* (pp. 197–227). Springer Open.

Capra, F. (2005). Speaking nature’s language: Principles for sustainability. In M. K. Stone & Z. Barlow (Eds.), *Ecological literacy: Educating our children for a sustainable world* (pp. 18–29). Sierra Book Club Books.

Carlsson, B. (2002). Ecological understanding 2: Transformation - a key to ecological understanding. *International Journal of Science Education*, 24(7), 701–715. https://doi.org/10.1080/09500690110098877

Chambers, D. W. (2003). The mumpsimus. *The Journal of the American College of Dentists*, 70(1), 31–35. https://europepmc.org/article/med/12772771
Charteris, J. (2016). Dialogic feedback as divergent assessment for learning: An ecological approach to teacher professional development. *Critical Studies in Education, 57*(3), 277–295. https://doi.org/10.1080/17508487.2015.1057605

Chong, S. W. (2021). Reconsidering student feedback literacy from an ecological perspective. *Assessment & Evaluation in Higher Education, 46*(1), 92–104. https://doi.org/10.1080/02602938.2020.1730765

Clifton, J. (2017). Taking the (heroic) leader out of leadership: The in situ practice of distributed leadership in decision-making talk. In C. Illé & S. Schnurr (Eds.), *Challenging leadership stereotypes through discourse: Power, management and gender* (pp. 45–68). Springer.

D'Andrade, R. (1984). Cultural meaning systems. In R. A. Shweder & R. A. LeVine (Eds.), *Culture theory: Essays on mind, self, and emotion* (pp. 88–119). Cambridge University Press.

Deleuze, G., & Guattari, F. (1987). *A thousand plateaus: Capitalism and Schizophrenia*. (B. Massumi, trans.). Bloomsbury.

Dobzhansky, T. (1973). Nothing in biology makes sense except in the light of evolution. *The American Biology Teacher, 35*(3), 125–129. https://doi.org/10.2307/4444260

Duclos, V., & Criado, T. S. (2019). Care in trouble: Ecologies of support from below and beyond. *Medical Anthropology Quarterly, 34*(2), 153–173. https://doi.org/10.1111/maq.12540

Duncan, C., & Sankey, D. (2019). Two conflicting visions of education and their consilience. *Educational Philosophy and Theory, 51*(14), 1454–1464. https://doi.org/10.1080/00131857.2018.1557044

Egerton, F. N. (2013). History of ecological sciences, Part 47: Ernst Haeckel's ecology. *Bulletin of the Ecological Society of America, 94*(3), 222–244. https://doi.org/10.1890/0012-9623-94.3.222

Ellaway, R. H., Bates, J., & Teunissen, P. W. (2017). Ecological theories of systems and contextual change in medical education. *Medical Education, 51*(12), 1250–1259. https://doi.org/10.1111/medu.13406

Fath, B. D., Dean, C. A., & Katzmaier, H. (2015). Navigating the adaptive cycle: An approach to managing the resilience of social systems. *Ecology and Society, 20*(2), 24. https://doi.org/10.5751/ES-07467-200224

Fernandez, A. A., & Shaw, G. P. (2020). Academic leadership in a time of crisis: The coronavirus and Covid-19. *Journal of Leadership Studies, 14*(1), 39–45. https://doi.org/10.1002/jls.21684

Gabriel, Y. (2016). Narrative ecologies and the role of counter-narratives: The case of nostalgic stories and conspiracy theories. In: S. Frandsen, T. Kuhn, and M.W. Lundholt (Eds.), Counter-narratives and Organization (pp. 208–226). London: Routledge

Glynn, S. M. (1991). Explaining science concepts: A teaching-with-analogies model. In S. M. Glynn, R. H. Yeany, & B. K. Britton (Eds.), *The psychology of learning science* (pp. 219–240). Lawrence Erlbaum Associates.

Golley, F. B. (1993). *A history of the ecosystem concept in ecology: More than the sum of the parts*. Yale University Press.

Gomez, S., Andersson, H., Park, J., Maw, S., Crook, A., & Orsmond, P. (2013). A digital ecosystems model of assessment feedback on student learning. *Higher Education Studies, 3*(2), 41–51. http://dx.doi.org/10.5539/hes.v3n2p41

Gorski, P. C. (2016). Poverty and the ideological imperative: A call to unhook from deficit and grit ideology and to strive for structural ideology in teacher education. *Journal of Education for Teaching, 42*(4), 378–386. https://doi.org/10.1080/02607476.2016.1215546

Gould, S. J. (1991). Exaptation: A crucial tool for an evolutionary psychology. *Journal of Social Issues, 47*(3), 43–65. https://doi.org/10.1111/j.1540-4560.1991.tb01822.x

Gravett, K., Yakovchuk, N., & Kinchin, I. M. (Eds.). (2020). *Enhancing student-centred teaching in higher education: The landscape of student-staff partnerships*. Palgrave Macmillan.

Guattari, F. (2014). *The three ecologies*. (I. Pindar & P. Sutton, trans.). Bloomsbury.

Gunderson, L. H., & Holling, C. S. (2002). *Panarchy: Understanding transformations in human and natural systems*. Island Press.

Holling, C. S. (1996). Engineering resilience vs. ecological resilience. In P. C. Schultze (Ed.), *Engineering within ecological constraints* (pp. 31–43). National Academy Press.
Holling, C. S. (2001). Understanding the complexity of economic, ecological, and social systems. *Ecosystems*, 4(5), 390–405. https://doi.org/10.1007/s10021-001-0101-5

Jax, K. (2007). Can we define ecosystems? On the confusion between definition and description of ecological concepts. *Acta Biotheoretica*, 55(4), 341–355. https://doi.org/10.1007/s10441-007-9024-7

Kemmis, S., Edwards-Groves, C., Wilkinson, J., & Hardy, I. (2012). Ecologies of practices. In P. Hager, A. Lee, & A. Reich (Eds.), *Practice, learning and change* (pp. 33–49). Springer.

Kinchin, I. M. (2000). From ‘ecologist’ to ‘conceptual ecologist’: The utility of the conceptual ecology analogy for teachers of biology. *Journal of Biological Education*, 34(4), 178–183. https://doi.org/10.1080/00219266.2000.9655715

Kinchin, I. M. (2016). *Visualising powerful knowledge to develop the expert student: A knowledge structures perspective on teaching and learning at university*. Sense Publishers.

Kinchin, I. M. (2019). Care as a threshold concept for teaching in the salutogenic university. *Teaching in Higher Education*, 1–14. https://doi.org/10.1080/13562517.2019.1704726

Kinchin, I. M. (2020). *Concept mapping and pedagogic health in higher education (a rhizomatic exploration in eight plateaus)* [DLitt Thesis, University of Surrey]. https://openresearch.surrey.ac.uk/esploro/outputs/docorial/Concept-mapping-and-pedagogic-health-in-higher-education-a-rhizomatic-exploration-in-eight-plateaus/99545423202346

Kinchin, I. M., Derham, C., Foreman, C., McNamara, A., & Querstret, D. (2021). Exploring the Salutogenic University: Searching for the triple point for the becoming-caring-teacher through collaborative cartography. *Pedagogika*, 141(1), 94–112. https://doi.org/10.15823/p.2021.141.5

Kinchin, I. M., & Gravett, K. (2022). *Dominant discourses in higher education: Critical perspectives, cartographies and practice*. London Bloomsbury.

Kinchin, I. M., & Miller, N. L. (2012). ‘Structural transformation’ as a threshold concept in university teaching. *Innovations in Education and Teaching International*, 49(2), 207–222. https://doi.org/10.1080/14703297.2012.677655

Kinchin, I. M., & Winstone, N. E. (Eds.). (2017). *Pedagogic frailty and resilience in the university*. Sense Publishers.

Kinchin, I. M., & Winstone, N. E. (Eds.). (2018). *Exploring pedagogic frailty and resilience: Case studies of academic narrative*. Brill.

Kinder, T., Stenvall, J., Six, F., & Memon, A. (2021). Relational leadership in collaborative governance ecosystems. *Public Management Review*, 23(11), 1612–1639. https://doi.org/10.1080/14719037.2021.1879913

Leijen, Å., Pedaste, M., & Lepp, L. (2020). Teacher agency following the ecological model: How it is achieved and how it could be strengthened by different types of reflection. *British Journal of Educational Studies*, 68(3), 295–310. https://doi.org/10.1080/00071005.2019.1672855

Lygo-Baker, S., Kinchin, I. M., & Winstone, N. E. (Eds.). (2019). *Engaging student voices in higher education: Diverse perspectives and expectations in partnership*. Palgrave Macmillan.

Malone, A., & Hogan, P. (2020). Evidence and its consequences in educational research. *British Educational Research Journal*, 46(2), 265–280. https://doi.org/10.1002/berj.3580

Manathunga, C., Selkirk, M., Sadler, K., & Kearny, K. (2017). Rendering the paradoxes and pleasures of academic life: Using images, poetry and drama to speak back to the measured university. *Higher Education Research & Development*, 36(3), 526–540. https://doi.org/10.1080/07294360.2017.1289157

Mazzei, L. A. (2016). Voice without a subject. *Cultural Studies ↔ Critical Methodologies*, 16(2), 151–161. https://doi.org/10.1177/1532708616636893

McGonigle, I. V. (2017). Spirits and molecules: Ethnopharmacology and symmetrical epistemological pluralism. *Ethnos*, 82(1), 139–164. https://doi.org/10.1080/00141844.2015.1042490

Miller, T. R., Baird, T. D., Littlefield, C. M., Kofinas, G., Chapin, F., & Redman, C. L. (2008). Epistemological pluralism: Reorganizing interdisciplinary research. *Ecology and Society*, 13(2), 46. https://doi.org/10.5751/ES-02671-130246

Molina-Motos, D. (2019). Ecophilosophical principles for an ecocentric environmental education. *Education Sciences*, 9(1), 37. https://doi.org/10.3390/educsci9010037
Mooney Simmie, G., Moles, J., & O’Grady, E. (2019). Good teaching as a messy narrative of change within a policy ensemble of networks, superstructures and flows. Critical Studies in Education, 60(1), 55–72. https://doi.org/10.1080/17508487.2016.1219960

Morens, D. M., & Fauci, A. S. (2020, September). Emerging pandemic diseases: How we got to COVID-19. Cell, 182(3), 1077–1090. https://doi.org/10.1016/j.cell.2020.08.021

Murray, C., Heinz, M., Munday, I., Keane, E., Flynn, N., Connolly, C., Hall, T., & MacRuairc, G. (2020). Reconceptualising relatedness in education in ‘Distanced’ Times. European Journal of Teacher Education, 1–15. https://doi.org/10.1080/02619768.2020.1806820

Nicholson, J., & Kurucz, E. (2019). Relational leadership for sustainability: Building an ethical framework from the moral theory of ‘ethics of care’. Journal of Business Ethics, 156(1), 25–43. https://doi.org/10.1007/s10551-017-3593-4

Noddings, N. (2012). The caring relation in teaching. Oxford Review of Education, 38(6), 771–781. https://doi.org/10.1080/03054988.2012.745047

Orr, D. W. (1992). Ecological literacy: Education and the transition to a postmodern world. SUNY Press.

Priestley, M., Biesta, G., & Robinson, S. (2015). Teacher agency: An ecological approach. Bloomsbury.

Roth, W.-M. (2018). The invisible subject in educational science. Journal of Curriculum Studies, 50(3), 315–332. https://doi.org/10.1080/00202072.2017.1373863

Sandri, O. (2020). What do we mean by ‘pedagogy’ in sustainability education? Teaching in Higher Education, 1–16. https://doi.org/10.1080/13562517.2019.1699528

Sansom, R. L. (2020). Pressure from the pandemic: Pedagogical dissatisfaction reveals faculty beliefs. Journal of Chemical Education, 97(9), 2378–2382. https://doi.org/10.1021/acs.jchemed.0c00657

Santos, B. D. S. (2014). Epistemologies of the South: Justice against epistemicide. Routledge.

Schön, D. A. (1971). Beyond the stable state: Public and private learning in a changing society. Temple Smith.

Sellor, S. (2015). A feel for numbers: Affect, data and education policy. Critical Studies in Education, 56(1), 131–146. https://doi.org/10.1080/17508487.2015.981198

Sermijn, J., Devlieger, P., & Loots, G. (2008). The narrative construction of the self: Selfhood as a rhizomatic story. Qualitative Inquiry, 14(4), 632–650. https://doi.org/10.1177/1077800408314356

Shahjahan, R. A. (2011). Decolonizing the evidence-based education and policy movement: Revealing the colonial vestiges in educational policy, research, and neoliberal reform. Journal of Education Policy, 26(2), 181–206. https://doi.org/10.1080/02680939.2010.508176

Shiva, V. (1998). Monocultures of the mind: Perspectives on biodiversity and biotechnology. Zed Books Ltd.

Sundstrom, S. M., & Allen, C. R. (2019). The adaptive cycle: More than a metaphor. Ecological Complexity, 39, 100767. https://doi.org/10.1016/j.ecocom.2019.100767

Suri, H. (2013). Epistemological pluralism in research synthesis methods. International Journal of Qualitative Studies in Education, 26(7), 889–911. https://doi.org/10.1080/09518398.2012.691565

Svenkerud, S. W., Madsen, J., Ballangrud, B. B., Strande, A. L., & Stenshorne, E. (2020). Sustainable use of ecological concepts in educational science. Discourse and Communication for Sustainable Education, 11(1), 153–162. http://dx.doi.org/10.2478/dcse-2020-0013

Toulmin, S. (1972). Human understanding. Volume 1, General introduction and part 1. Clarendon Press.

Van Vugt, M., & Von Rueden, C. R. (2020). From genes to minds to cultures: Evolutionary approaches to leadership. The Leadership Quarterly, 31(2), 101404. https://doi.org/10.1016/j.leaqua.2020.101404

Varey, W. (2011). Viability of psychological panarchy: Thought as an ecology. Systems Research and Behavioral Science, 28(5), 509–525. https://doi.org/10.1002/sres.1112

Walk-Shannon, E., Batzli, J., Pultorak, J., & Boehmer, H. (2019). Biological variation as a threshold concept: Can we measure threshold crossing? CBE – Life Sciences Education, 18(ar36), 1–15. https://doi.org/10.1187/cbe.18-12-0241

Watermeyer, R., Crick, T., Knight, C., & Goodall, J. (2021). COVID-19 and digital disruption in UK universities: Afflictions and affordances of emergency online migration. Higher Education, 81(3), 623–641. https://doi.org/10.1007/s10734-020-00561-y
Watson, G. R. (1986). *Conceptual change: An ecosystemic perspective on children’s beliefs about inheritance* [PhD Thesis, University of Surrey]. https://openresearch.surrey.ac.uk/esploro/outputs/doctoral/Conceptual-change-An-ecosystemic-perspective-on-childrens-beliefs-about-inheritance/99516245502346

Watts, E., Höffeld, U., & Levitt, G. S. (2019). Ecology and evolution: Haeckel’s Darwinian paradigm. *Trends in Ecology & Evolution*, 34(8), 681–683. https://doi.org/10.1016/j.tree.2019.04.003

Wilson, E. O. (1998). *Consilience: The unity of knowledge*. Vintage Books.