Ecological perspectives on learning and methodological implications for research

Lina Markauskaite,

The University of Sydney, NSW, Australia

Lucila Carvalho,

Massey University, New Zealand

Crina Damşa

University of Oslo, Norway

This is the final draft of the chapter submitted 14 January 2023

Please, cite and quote the published version:

Markauskaite, L., Carvalho, L., & Damşa, C. (2023). Ecological perspectives on learning and methodological implications for research. In C. Damşa, A. Rajala, G. Ritella, & J. Brouwer (Eds.), *Re-theorising learning and research methods in learning research* (pp. 30–46). Routledge. DOI: 10.4324/9781003205838-3

Chapter 2: Ecological perspectives on learning and methodological implications for research

Lina Markauskaite, Lucila Carvalho and Crina Damşa

Abstract: This chapter discusses ecological perspectives on learning and their methodological implications for empirical research. Ecology – originating in the study of the relationships of organisms between one another and their environments – is a central subject in biology. Perspectives grounded in ecological ways of thinking have also been developed and applied in various other domains, such as psychology, anthropology and sociology. In education, ecological perspectives offer a set of valuable conceptual tools for examining learning in a complex, interrelated world, as they account for diverse learners' interactions within various environments. These perspectives are timely, considering the current complex epistemological, social and institutional contexts, where learning is intertwined with human subjectivities, collective human cultures and their surroundings. We elaborate on the theoretical notions and discuss the implications of considering teaching and learning as a dynamic and organic process woven within learners' lives and pathways rather than an independent, linear and predictable course. We illustrate how ecological perspectives could be applied for analysing informal learning and discuss the key methodological challenges and implications.

Introduction

Rapid growth and the increasing complexity of knowledge, alongside the proliferation of digital technologies and networks, have created new learning opportunities. Distributed learning practices and spaces have become more salient. Learning is now simultaneously autonomous and collaborative: it takes place in dynamic and unbound environments that span school, family, community and interest groups (Jornet & Damşa, 2020). Learning activity capitalises on *personal and collective resources* and is situated in, and distributed across, settings and contexts (Akkerman & Bakker, 2011). Therefore, an ecological analytical lens is needed to understand the intricacy of human learning and to inform practice.

In this chapter, we elaborate on and employ ecological perspectives on learning to examine and illustrate how the ecological notions that constitute these perspectives can be analytically applied. We focus on the recent pragmatic turn in ecological theorisations of learning towards actionable 'mid-range' accounts (e.g. Ellis & Goodyear, 2018; Hammer et al., 2018). Insights from such analysis help us to understand how learning ecologies function and how ecological frameworks can be analytically used, therefore informing further research, decision-making, design and action.

We first present an overview of ecological concepts and theoretical perspectives. Next, we illustrate how methods and insights from different ecological frameworks can be integrated and used for empirical analysis. We draw on a case of an educational initiative for engaging Brazilian citizens in civic matters to show how different ecological lenses can be used to examine a complex learning activity. Finally, we discuss the challenges in theorising and studying learning as an ecological phenomenon and consider the future methodological directions.

Ecologies and learning: Definitions

The term 'ecology' has its roots in the Latin word *oeco*, meaning 'household', and *-logia*, a 'branch of learning' or 'study of'. In environmental sciences, ecology is broadly defined as the study of the relationships between living organisms and their environments as they interact with one another within the ecosystems they comprise. Ecosystems have two defining characteristics. First, they are multi-layered and composed of organisms, populations and communities, each with specific traits developed through their life history. Second, dynamic interactions between elements, within and across levels of ecology, sustain those ecosystems and drive their development. Such development is inseparable from the development of its individual elements and is influenced by their relationships.

Learning systems have many similar features to environmental systems: they are multi-layered – from micro-processes at the neurobiological level to cultures of diverse learning communities – and characterised by dynamic relationships between interacting elements within and across the layers. Learning is a process that evolved throughout the life history of the human species; it is as natural as it is made/artificial (Markauskaite & Goodyear, 2017). Therefore, those who research learning do this at multiple levels – 'from neurons to neighbourhoods'. Environmental scientists often study specific bounded phenomena in ecosystems to understand them and create 'mid-range' theoretical explanations that can inform solutions to local environmental challenges (Meyfroidt et al., 2018). Similarly, learning scientists often need to study learning activities in specific settings to understand complex learning challenges and create 'mid-range' theoretical explanations to inform solutions to these challenges (Plomp & Nieveen, 2013).

In the educational literature, ecological perspectives have been used in two major ways: as theoretical frameworks and as applied analytical approaches. The *theoretical* perspectives usually describe the ecologies of human development and learning by providing accounts of what constitutes such ecologies and how they function. For example, Lee (2017) describes the ecology of human development as

> *the unfolding of dynamic relationships* among characteristics of the individual as these interact with—shape and are shaped by—features of the social spaces in which the individual operates (e.g., nuclear family, extended family, social networks of peers and adults, socially organized settings outside the home such as church, school, community settings, etc.). (p. 94)

The *analytical* perspectives use ecological approaches as methodological tools to study educational settings and learning (Ellis & Goodyear, 2018; Hammer et al., 2018). For example, Ellis and Goodyear (2018) describe educational ecology as an applied perspective

> useful for understanding educational activities and outcomes and also for producing actionable knowledge—knowledge that is useful in designing, creating and managing those elements of educational ecosystems. (p. 12)

They argue that the creation of such actionable knowledge depends on understanding the internal logic of evolving educational ecosystems – 'knowing how to evaluate, what data to collect, how to connect sources of evidence in a robust explanatory framework, and so on' (p. 12).

In this chapter, we integrate the theoretical and analytical views of ecology and demonstrate how ecological lenses can be used for examining learning ecosystems in authentic learning settings.

Ecological perspectives as theoretical frameworks

Ecological theories for conceptualising and studying learning phenomena have emerged through diverse yet intersecting intellectual pathways and inevitably have similarities as they have differences. These theories form an *ecology of ecological perspectives*. Therefore, in describing this theoretical ecosystem, we adopt an ecological disposition and do not hide overlaps or deny variations. Rather, we describe three perspectives that have 'family resemblance': 1) person-focussed, 2) relations-focussed and 3) community-focussed. They depict learning at different levels of the learning ecosystem – from individuals to collectives – and are analytically complementary. In what follows, we discuss their typifications.

Person-focussed perspectives

The use of ecological notions to theorise human development, cognition and learning is not new. These notions include theories of human ecological development, ecological psychology, distributed cognition and the recently emerging perspectives of embodied, enacted, embedded and extended cognition.

Regarding human development, Bronfenbrenner's (1979) ecological model emphasises that individuals do not develop in isolation from their environments; instead, they are often influenced by school, home, community and other broader societal factors. These factors are seen as multiple layers of the environment surrounding the individual: from immediate settings to neighbourhoods, broad cultural environments and transitions through one's lifetime.

Similar ecological notions have been embraced in studies of human cognition in natural contexts (Hutchins, 2010). Gibson's (1979) ecological psychology primarily focuses on how visual perception emerges from the dynamic coupling between organisms and their physical environment. Contemporary theories of embodied, enacted, embedded and distributed cognition aim to highlight how higher cognitive processes, such as thinking and problem-solving, are intertwined with social and material surroundings (Hutchins, 2010; Newen et al., 2018). These perspectives move away from analysing learning and cognition as properties of an isolated human mind towards studying dynamic patterns of interaction between mental activities, embodied actions and an ever-changing structure of the material and sociocultural environment. According to Hutchins (2010), 'activity in the nervous system is linked to high-level cognitive processes by way of embodied interaction with culturally organized material and social worlds' (p. 712).

Such reconceptualisation of human development and cognition has profound implications for what can be considered as a unit of analysis when researching learning. The study of internal structures and cognitive processes must expand to include external structures, artefacts and human collectives. Further, studying how the body and mind are coupled with multiple elements in a profoundly heterogeneous environment requires attending to different modalities of human interaction with each other (speech, gesture, etc.) and non-human surroundings *rather than just thinking*. More importantly, the environment is as much the cause of cognition as it is the product of human cognitive activities and learning. Therefore,

the ecology of learning must extend from the study of inter-mental and intra-mental processes that constitute individual development towards the study of cultural–cognitive ecosystems that co-develop (Hutchins, 2014).

Overall, person-focussed ecological perspectives acknowledge the role of external environments and human collectives; however, the focus is on how they intersect with human cognition and development. These perspectives have resulted in the emergence of distinct methodological and analytical approaches, such as natural experiments, cognitive ethnographies and material and multimodal blending that enable the study of ecosystems in which human cognition is enmeshed across modalities and at different spatial and temporal scales.

Relations-focused perspectives

Ecological notions also permeate a broad family of sociocultural, sociomaterial and cultural–historical approaches to learning that have their roots in Vygotsky's (1987) sociocultural psychology and ecological realism (Reed, 1992). Their focus is on the mutually constitutive relations between individuals and the larger institutional (educational) and societal contexts as well as on how these relationships are involved in the processes of learning and development.

Vygotsky's (1987) interpretation that human action is mediated by tools and signs, including objects, materials, language, symbol systems, schemes and representations, provides a baseline for understanding the ecological perspectives on learning rooted in sociocultural notions. The focus is on how tools and signs mediate relations and interactions and contribute to collective meaning-making processes.

Two interlocked postulates characterise this view of learning (Damşa & Jornet, 2017). According to the first postulate, in learning, not only the person but also their sociocultural environment is transformed. The relationship between the individual(s) and their sociocultural environments is viewed as the key phenomenon of interest. Human actions and the sociocultural environment become mutually interconnected through material, symbolic activities and available tools (Matusov, 1996). The individual is actively relating to the environment and other individuals – receiving and transforming semiotically encoded information from/about the world into internalised personal knowledge (Vygotsky, 1987). However, the process is not unidirectional. Individuals' knowing and being become externalised in various forms – actions, artefacts and language – and enter the environment (Valsiner & Van der Veer, 2000).

According to the second postulate, in learning, not only knowledge but also the whole person is transformed. Learning is seen as a process of constant becoming, in which knowledge is continuously (re)constructed based on information available in the environment (Packer & Goicoechea, 2000) but where body and mind are inseparable from the environment people inhabit (Reed, 1992) (see also the person-focussed perspective).

Ontologically, in this view, not the mind or specific objects but the available information in the environment with which learners create relationships is considered relevant (Reed, 1992). This ontology is relational because learners perceive and act relative to themselves and the sources of information they explore. In addition, a learner is thus not just an intellectual agent but someone who engages in performative and affective relations with others and the environment and, in doing so, develops their identity.

Whereas relations-focused and person-focused perspectives intersect, relational perspectives have as their main premise the mediating role of social and material culture; they focus on the relations between intersubjective and interactional meaning-making. These perspectives have resulted in the emergence of distinct analytical approaches, such as interaction analysis, sociocultural discourse analysis, chronotope analysis and analysis of mediated action, which enable examinations of the relational and mediated dimensions of human action enmeshed with the social, cultural or material environment.

Community-focussed perspectives

Some ecological perspectives, such as social and human ecology (Poston, 2015; Stokols, 2017) and networked learning (NLEC, 2021), focus on phenomena that emerge from particular co-configurations of, and interactions within, larger heterogeneous collectives of people and their environments. These perspectives acknowledge the multi-layered and intertwined nature of multiple social, virtual, built and natural systems and focus on phenomena that emerge at the aggregated levels, such as flows of ideas in a social network, geospatial patterns as well as processes that drive school exclusion. The basic units of analysis are networks, communities, populations and other constellations, and the focus is on dynamically emerging (rather than structurally defined) relationships. Community-focussed ecological concepts and methods are increasingly being used to study learning in social movements and other heterogeneous collectives working to address complex societal issues, thus becoming intertwined with transformative action-oriented research (Stokols, 2017).

These community-focussed ecological ideas are echoed in some perspectives of networked learning, particularly those deep-rooted in critical theory (Carvalho et al., 2017). They embrace the notions of openness, fluidity and connections and emphasise the development of a learning culture that reflects the active social roles and agency of learners and teachers (Jones, 2015). A networked learning stance emphasises cooperation, collaboration and dialogical activity as part of the learning process – thus valuing self-determination and different perspectives – and considers technologies as tools to connect and mediate learning activity (Hodgson & McConnell, 2019).

Community-focussed perspectives focus on changes at a collective level and are less interested in individual cognition or activities that do not result in broader effects. Therefore, the main analytical focus is on the qualities, processes and connections that result in emerging properties at a collective level (groups, networks, communities, etc.). These perspectives embrace a range of methods for studying relationships and emergence, such as geospatial mapping and social network analysis. They also include tools for analysing relationships between design and emerging activity, such as the Activity-Centred Analysis and Design framework (Goodyear & Carvalho, 2014).

Investigating learning ecologies: Topologies of units of analysis

All ecological perspectives acknowledge the importance of individual agents and their environments and pay close attention to their relationships. Nevertheless, each perspective implies a distinct focus of investigation and a different topology of their units of analysis.

Person-focussed perspectives focus on human cognition, learning and development in an ecosystem. Accordingly, they place an individual at the centre of the unit of analysis. The topology of such a unit of analysis is typically depicted in concentric cycles, with an

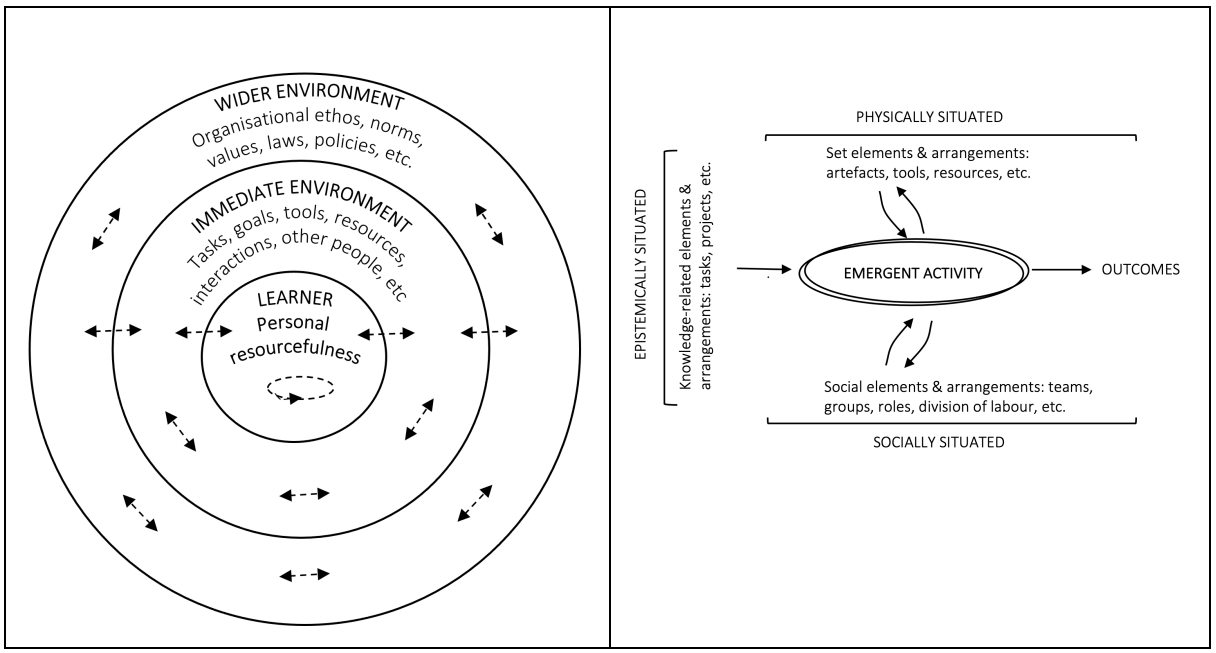
individual at the centre surrounded by their environments and the interactions among them. For example, Figure 1A shows a typical representation of person-centred ecological models.

Relations-focussed perspectives expand the focus from individual cognition to systems, composed of humans and other resources in their sociocultural and material environments. The topology of such a unit of analysis often depicts the main relations and interactions among multiple human and nonhuman agents that need to be considered. For example, Figure 1B depicts learning activity as an interaction between a human subject and their sociocultural and material environment.

Community-focussed perspectives focus on complex co-evolving relationships and activities distributed across different aspects of ecology. The unit of analysis shifts from individual agents to elements and processes that shape collective activities. The topology of such a unit of analysis usually centres on activity and organically evolving rhizomatic relationships. For example, this typology is captured in a framework often used for activity-centred analyses of networked learning, where learning is seen as epistemically, physically and socially situated and learning activity is seen as dynamically emerging from interactions between knowledge-related, set and social elements and arrangements (Figure 1C).

A comprehensive analysis of learning requires acknowledging the multiple interacting layers of learning ecologies – from individual agents to collectives – and multiple timescales – from microseconds to historical and evolutionary timeframes. Therefore, the ecological approaches to understand learning across the entire cognitive-cultural ecosystem need to do this across multiple timeframes and scales. The topology of such a unit of analysis could be depicted as a multi-layered, dynamically evolving ecosystem that connects individual learning with interactions within the immediate and wider environments (Figure 1D).

The typifications in Figure 1 do not capture variations and nuances; nevertheless, they illustrate the analytical structure and focus of the selected ecological perspectives.



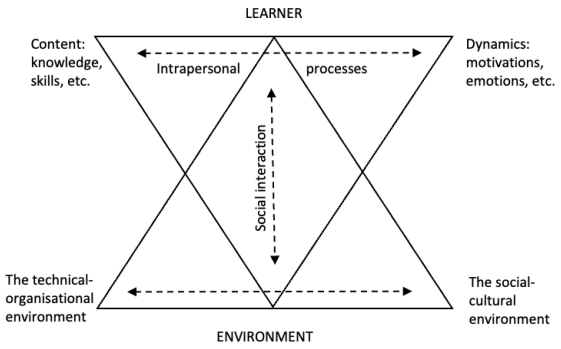
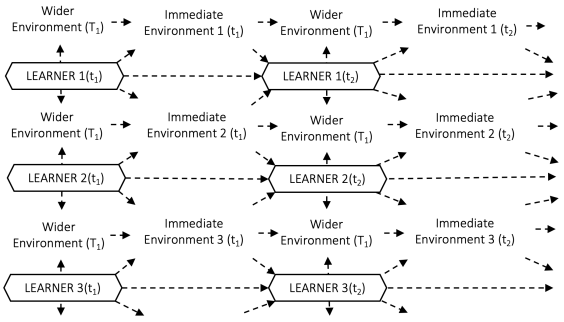
A. Person-focussed topology (based on Guy-Evans, 2020)	C. Community-focussed topology (based on Goodyear & Carvalho, 2014, p. 59)
	
B. Relations-focussed topology (based on Illeris, 2004, p. 438)	D. Multi-layered topology. T – cultural timescales, t – microgenetic timescales

Figure 2.1. Topologies of learning ecologies

An empirical case: Fast Food da Politica

To illustrate how ecological concepts can aid in empirical analysis, we chose a complex, multi-layered case involving individual and collective learning in an environment hosting a complex political phenomenon. This case allows us to examine how learning is understood and enacted from multiple ecological perspectives and to consider the theoretical and methodological implications.

Description

Fast Food da Politica (FFDP) is a not-for-profit organisation located in Brazil (Carvalho et al., 2021). FFDP was founded during a time of significant political unrest, when the country was on the verge of a presidential impeachment. Its goal was to design games and offer fun opportunities for people to engage in critical thinking about politics and their civil rights, thus empowering Brazilians to learn about these topics.

The empirical data collected for analysing learning facilitated by FFDP comprised game designs and materials, broad observations of people engaging with the games and interviews with the designers. We begin our analysis by describing FFDP at three levels: the broad, related to the context; the local, related to FFDP's vision and practices; and the detailed level, related to the specifics of design and activities. Next, we discuss how emerging relationships and learning could be interpreted from different ecological perspectives.

At the *broad level*, FFDP is situated within the Brazilian context and at a time when people were experiencing social, political and economic divisions. The culturally sensitive concept of 'fast food' is chosen as part of the organisation's name for its appeal to Brazilian youth disengaged from politics. The organisation uses stylised images of a hamburger and the Brazilian Congress building (at the centre in Figure 2) that combine to form FFDP's logo (at the right in Figure 2). FFDP has been developing a curriculum for learning about politics

grounded in the mechanisms of Brazilian government structures, the system of powers (legislative, executive and judiciary) and hot topics in pre-election debates, such as gender representation. The increasing popularity of open-access design culture and the public appeal of gaming pedagogy provide additional context for FFDP's design.

Figure 2.2. Fast Food Da Politica logo (FFDP, 2017)

At the *local level*, the main elements of FFDP's learning ecosystem are shaped by FFDP's vision that is grounded in the principles of inclusion. This vision involves the development of political games that can be played by people from different social classes and of different ages and ethnicities. Games may be about the election process, understanding the governing political structures or the importance of carefully choosing representative members. To achieve inclusivity, FFDP uses mechanics from games well-known to Brazilian people, such as basketball or 'Guess Who'. Inclusivity is also reflected in FFDP's open-access design practices and mechanisms for sharing blueprints of their games within a wider community in online spaces.

At the *detailed level*, the games are colourful, aimed at engaging people in embodied physical interactions. For example, the physicality of games is expressed in a super-sized version of 'Guess Who' (Figure 3) that was created to incite conversations about politicians, their positions and roles in the government, and party alliances. Despite their playful appearance, the games pose serious questions, such as: 'What is the presidential line of succession?' 'What role is responsible for what?' FFDP organises game sessions in a range of formal and informal learning settings, including schools, street markets and protests, creating diverse opportunities for learning to emerge – for example, as a passer-by stops to participate in a game session in a street market.

Some FFDP activities connect across the levels. For example, game sessions held within public schools include professional development for teachers (*detailed level*). For these sessions, teachers act as developers: they are invited to think and share new ways of playing an existing game or to contribute ideas for a new game (*local level*). New ideas are then packaged and shared through FFDP's website with the wider community, contributing to open-access design culture (*broad level*). Overall, multiple types of learning activities exist because FFDP's designers are still learning about how to engage the community and how to share the resources they create. These activities are expected to contribute to transformative changes at the community scale.

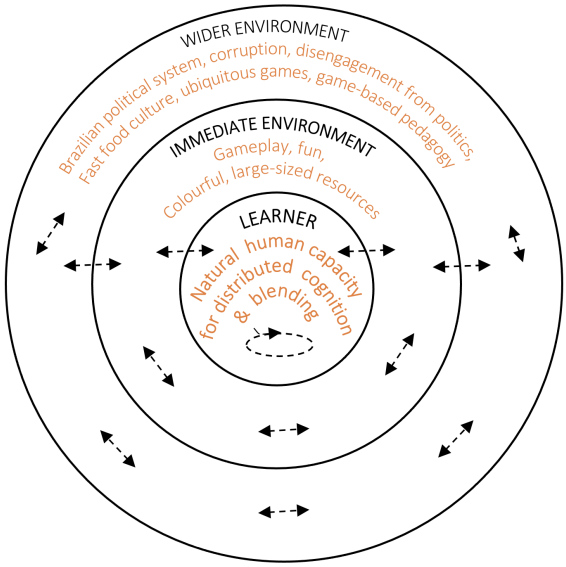
Figure 2.3. A super-sized version of 'Guess Who' (Carvalho et al., 2021, p. 14)

Analysis and discussion

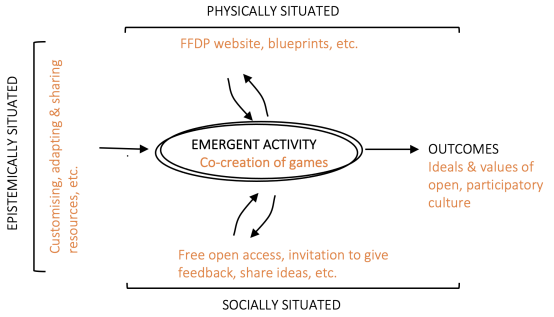
FFDP represents a rich educational ecosystem that can be analysed from multiple ecological perspectives.

From the person-focussed perspective, FFDP's activities embrace the ecology of human cognition, which is at the centre of analysis (Figure 4A). For example, reliance on the mechanics and rules of familiar games in the Brazilian cultural context allows drawing on a rich array of personal resources that people bring to learning settings. The material qualities of colourful, large-sized game resources support different modalities of human interaction, including gestures, bodily movement, speech and emotion, and anchor the learning of abstract political concepts and procedures in the designed material surrounding and embodied experiences rather than just in thought.

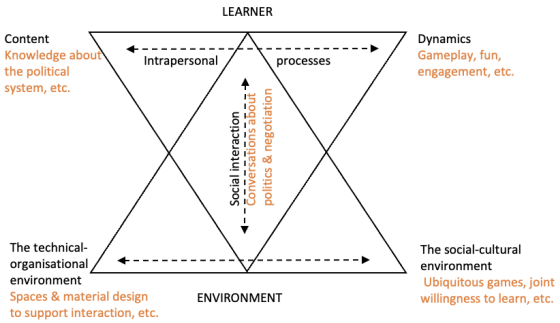
Figure 2 illustrates the analytical power of *person-focussed perspectives* using the example of FFDP's logo. Analytical approaches such as multimodal blending (Markauskaite et al., 2021) can be used to understand how this design contributes to meaning-making and increases the logo's appeal among the general public. The concept of multimodal blending suggests that humans construct new meanings by blending elements from different conceptual arrays anchored in their previous experiences, material environment, bodily actions and dynamically emerging activity. This blending is apparent in FFDP's logo. Here, the elements from the conceptual array of 'fast food' (easily consumable, attractive, unhealthy, etc.) are blended with the elements from the conceptual array of 'politics' (non-transparent, complicated, corrupted, etc.) to induce the meaning that learning about Brazilian politics is easily accessible, although its content is not necessarily unproblematic and 'healthy'. Here, the design of the logo richly draws on the embodied experiences of fast food to induce a positive epistemic emotion 'it is easy' and prepare learners to critically engage with knowledge about Brazilian politics: 'it is not necessarily healthy'. This conceptual blending is intertwined with the visual-semiotic blending of the iconic representations of the hamburger and the sketch of the parliament building in FFDP's logo.



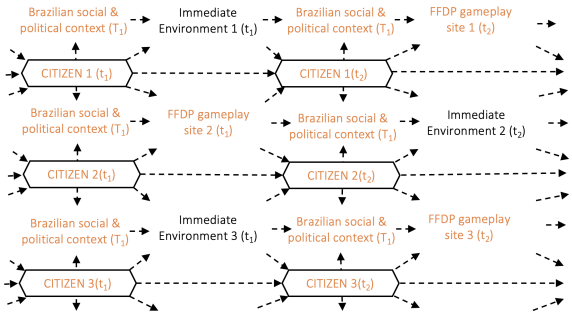
A. Person-focussed perspective



C. Community-focussed perspective



B. Relations-focussed perspective



D. Multi-layered ecology perspective. T – cultural timescales, t – microgenetic timescales

Figure 2.4. Analysis of FFDP through different ecological lenses

From the relations-focussed perspective, FFDP's learning activities are interactional in nature. All participants are engaged in a performative practice that embeds the knowledge of politics and gameplay. The verbal and embodied interactional exchanges entail an implicit negotiation process (of knowledge, ideas, opinions, etc.) built into FFDP's game pedagogy. This is a multi-directional process in which various parties have contributed (through game designs, knowledge about politics, crafted game materials, performance, etc.) to the meaning-making process and where all are willing to learn from it. The design mediates an intellectual interdependence, wherein individual and collective are intertwined.

In relations-focussed perspectives, we shift our analytical focus from individuals and their embodied engagement with large game pieces towards examining relationships and, for example, noticing how the game pieces mediate social interactions when participants engage in joint performative acts. Certain games are used for 'calling out' those who pass by, fulfilling specific interpersonal and intra-personal functions related to bringing people in to

participate in conversations. Meaning-making here is connected to people's willingness to negotiate knowledge about politicians and their roles in government, which is experienced through the dynamics of motivations, emotions, etc. that interactions with others bring (Figure 4B).

From the community-focussed perspective, transformational learning at a collective level is an essential feature of FFDP. FFDP's design and learning processes are grounded in cooperation, collaboration and other values of networked learning (Hodgson & McConnell, 2019). For example, FFDP offers opportunities for such learning when it encourages people to share ideas about the political structures of the Brazilian government, discuss government roles and responsibilities and reflect on gender representation within politics. Further, FFDP's games and events are designed taking inclusion and diversity into consideration and thus aim to include 'all voices' from different social classes, ages, ethnicities, work experiences, etc.

By considering FFDP's ecosystem from a community-focussed perspective, we broaden our analysis to include how FFDP promotes community learning by inviting people to co-create games and participate in FFDP's network. Note that FFDP incites participation and co-creation when making their blueprints freely available for download on their website, when asking for feedback and ideas about how others might use these resources and when 'teaching' others about how to customise and adapt resources. In so doing, FFDP is not only disseminating their ideas about how a particular game might be played but also inviting people to join their ideals – disseminating their values of open, participatory culture and fostering joint transformative learning (see Figure 4C).

An integrative multi-layered ecological lens allows placing the individual and collective meaning-making processes in a broader context, where situated actions and relationships are a starting point for transformations at various scales. In a given moment of encountering FFDP's tools (e.g. the games) and activities (e.g. game playing), the transformation is most impactful for individuals and groups playing the game and their knowledge or understanding of the political system. Nevertheless, this is a springboard for development at a broader community scale, as game design and participation lay the basis for potential new trajectories of individuals as electorate members, new activities with civic value and new views towards politics in Brazil (Figure 4D).

The integrative perspective helps us understand how transformative learning at a community scale can emerge from a series of FFDP's learning events that occur in different settings and over time. It encourages us to critically consider the nuances of FFDP's designs on people's meaning-making and relationships as well as how the details of various learning and community-building activities are influenced by and influence the broader environment. This perspective enables educational designers and practitioners to view the learning ecosystem as a whole and to consider how their actions contribute to configuring the immediate environment and how they can best contribute to transformative learning at a larger scale.

Reflection: Ecological notions as analytical instruments

Our analysis of the empirical case and our elaborations illustrate some key aspects of ecological perspectives. Overall, ecological lenses enable us to examine how learning emerges from multiple interconnected processes and help us more holistically understand

learning. However, the current conceptualisations and analytical tools are not without limitations. In our view, the theoretical, methodological and practical value of ecological perspectives hinges on four fundamental advances.

First, current ecological approaches are more potent at depicting *the presence* of dynamic relationships between different elements of the learning ecosystem than at unpacking the *mechanisms* of how these relationships form, function or change. Therefore, advances in this field hinge on the theoretical progress in constructing robust explanations of how different elements of the learning ecosystem interact. Such progress likely relies on embracing theories of complexity, dynamic systems and other emerging explanatory approaches that allow accounting for variability and model emerging nonlinear interactions among multiple elements (Barsalou et al., 2007).

Second, ecological perspectives create a natural arena for significant methodological advancement. Empirical methods currently used in educational research are often too *limited* for depicting the ecological nature of learning. Multiple data collection techniques are necessary to unpack the different modalities of learning (from biological processes to observable behaviour) and trace learning across settings (from school to home, to street and to virtual spaces) and at different timescales (from milliseconds to decades). We have already seen the emergence of methodological approaches that help study learning as an ecological phenomenon, such as cognitive ethnography, multimodal blending and activity-centred analysis. Currently available methods, infrastructures and practices are usually limited to studying learning from a particular ecological perspective and in very small ecosystems (e.g. a group or an organisation). These need to be expanded to study learning as a multi-layered dynamic phenomenon in much larger learning ecosystems. Future progress is likely to be inseparable from advances in educational data infrastructures and digital research practices that may allow us to dig deeper into the specific aspects of learning and study across longer timescales and larger ecosystems (Poquet et al., 2021).

Third, ecological perspectives enable a fundamental discussion about the arrays of research paradigms and methods employed in learning and educational research. Such discussion invites rethinking the relationship between ecology as a grand theoretical perspective that aims to construct a comprehensive understanding of learning and ecology as an applied practice-oriented approach that seeks to understand learning in specific ecological settings and produce mid-range theoretical explanations that inform action. As Hammer et al. (2018) argue, ‘letting go of universal laws in favour of mid-level possible mechanisms, looking across scales and embracing variation’ (pp. 640–641) could be a productive direction for educational research. From this perspective, current advances in ecological theories and empirical methods are more readily suitable for producing actionable knowledge that weaves the study of emerging learning practices in specific local settings with educational design and change-oriented decision-making. Progress in this direction also requires harnessing theoretical and methodological connections between various ecological perspectives. This comes in sharp contrast to the common scholarly ambition to preserve ontological and epistemological purity and to delineate clear boundaries between disciplines and theoretical orientations.

Finally, many ecological perspectives of learning have mainly embraced descriptive and explanatory goals; however, as some researchers have pointed out, the mission of ecological perspectives should also be transformative and moral (Stokols, 2017). The turn towards truly transformative ecological theories of learning will likely require the embracement of

learning-oriented ontological and epistemological stances such as those seen in conceptualisations of research as a 'learning system' (Ison et al., 2021).

To make ecological perspectives truly transformative, these four developments must be simultaneously pursued.

Conclusion

Ecological perspectives broadly acknowledge that learning is a complex, dynamic, relational phenomenon constituting multiple elements and relationships, from human biology and cognition to social and material environments and cultures. These theoretical perspectives and associated methods aim to overcome the limitations of studying learning as a direct causal phenomenon by isolating and investigating the impact of changes in specific elements on specific learning outcomes. They offer a toolkit for holistically analysing learning by unpacking the relations among different elements of learning ecosystems.

However, ecological perspectives are not one unified, all-encompassing theoretical framework or one methodology. They are a set of loosely connected theoretical approaches that have some common and some distinct roots and emerged through deterrent intellectual pathways in different disciplinary fields. They embrace a broad range of methodological and analytical approaches, such as ecological experiments, ethnomethodology, interaction analysis, case study, ethnography, social network analysis and geospatial analysis.

As a result, research within this domain is uniquely placed to draw on a broad methodological toolkit that helps understand learning within and across learning settings and at different time scales. Owing to its composite nature, adopting an ecological perspective for research on learning also requires an ecological disposition towards the research process itself. This disposition involves sensitivity to the variability of theoretical and methodological approaches and their relationships as well as an inclination to work across ontological, epistemological and methodological traditions.

Acknowledgements

The work of Lina Markauskaite was partly funded by the Australian Research Council through grant DP200100376 and NSW Department of Education through grant G212673. The work of Crina Damşa was partly funded by the Department of Education at University of Oslo and Research Council of Norway through grant 321369. Figures 2.2 and 2.3 were sourced from Fast Food da Politica under the Creative Commons license with Attribution-NonCommercial-ShareAlike 4.0.

References

Akkerman, S. F., & Bakker, A. (2011). Boundary crossing and boundary objects. *Review of Educational Research*, *8*, 132–169. https://doi.org/10.3102/0034654311404

Barsalou, L. W., Breazeal, C., & Smith, L. B. (2007). Cognition as coordinated non-cognition. *Cognitive Processing*, *8*(2), 79–91. doi: 10.1007/s10339-007-0163-1

Bronfenbrenner, U. (1979). *The ecology of human development: Experiment by nature and design.* Harvard University Press.

Carvalho, L., Goodyear, P., & de Laat, M. (2017). Place, pace, and networked learning. In L. Carvalho, P., Goodyear, & M. de Laat (Eds.), *Place-based spaces for networked learning* (pp. 1–10). Routledge.

Carvalho, L., Yeoman, P., & Carvalho, J. (2021). It's your turn! Supporting social change through networked learning and game playing. In N.B. Dohn, J. J. Hansen, S. B. Hansen, T. Ryberg, & M. de Laat (Eds.), *Conceptualizing and innovating education and work with networked learning* (pp. 115–133). Springer. https://doi.org/10.1007/978-3-030-85241-2_7

Damşa, C. I., & Jornet, A. (2017). Revisiting learning in higher education—Framing notions redefined through an ecological perspective. *Frontline Learning Research Journal*, *4*(2), 12–20. http://dx.doi.org/10.14786/flr.v4i4.208

Ellis, R. A., & Goodyear, P. (2018). *The education ecology of universities: Integrating learning, strategy and the academy*. Routledge.

Gibson, J. J. (1979). *The ecological approach to visual perception*. Houghton Mifflin.

Goodyear, P., & Carvalho, L. (2014). Framing the analysis of learning network architectures. In L. Carvalho & P. Goodyear (Eds.), *The architecture of productive learning network*s (pp. 48–70). Routledge.

Guy-Evans, O. (2020, Nov 09). Bronfenbrenner's ecological systems theory. *Simply Psychology*. Retrieved on December 11, 2022, from https://www.simplypsychology.org/Bronfenbrenner.html

FFDP (2017). Apresentação institutional. Retrieved on January 7, 2023, from https://transforma.fbb.org.br/storage/socialtecnologies/283/files/apresentacao_institucional%20(1).pdf

Hammer, D., Gouvea, J., & Watkins, J. (2018). Idiosyncratic cases and hopes for general validity: What education research might learn from ecology. *Journal for the Study of Education and Development*, *41*(4), 625–673. doi: 10.1080/02103702.2018.1504887

Hodgson, V., & McConnell, D. (2019). Networked learning and postdigital education. *Postdigital Science and Education*, *1*(2), 43–64. doi: 10.1007/s42438-018-0029-0

Hutchins, E. (2010). Cognitive ecology. *Topics in Cognitive Science*, *2*(4), 705–715. doi: 10.1111/j.1756-8765.2010.01089.x

Illeris, K. (2004). A model for learning in working life. *Journal of Workplace Learning*, *16*(8), 431–441. https://doi.org/10.1108/13665620410566405

Ison, R. L., Collins, K. B., & Iaquinto, B. L. (2021). Designing an inquiry-based learning system: Innovating in research praxis to transform science–policy–practice relations for sustainable development. *Systems Research and Behavioral Science*, *38*(5), 610–624. https://doi.org/10.1002/sres.2811

Jones, C. (2015). *Networked learning: An educational paradigm for the age of digital networks.* Springer.

Jornet, A., & Damşa, C. (2020). Unit of analysis from an ecological perspective: Beyond the individual/social dichotomy. *Learning, Culture and Social Interaction*, 31, Part B, doi: 10.1016/j.lcsi.2019.100329

Lee, C. D. (2017). Integrating research on how people learn and learning across settings as a window of opportunity to address inequality in educational processes and outcomes. *Review of Research in Education*, *41*(1), 88–111. doi: 10.3102/0091732x16689046

Markauskaite, L., & Goodyear, P. (2017). *Epistemic fluency and professional education: Innovation, knowledgeable action and actionable knowledge.* Springer.

Markauskaite, L., Goodyear, P., & Sutherland, L. (2021). Learning for knowledgeable action: The construction of actionable conceptualisations as a unit of analysis in researching professional learning. *Learning, Culture and Social Interaction*, *31*, 1–13. doi: 10.1016/j.lcsi.2020.100382

Matusov, E. (1996). Intersubjectivity without agreement. *Mind, Culture, and Activity*, *3*(1), 25–45. doi: 10.1207/s15327884mca0301_4

Meyfroidt, P., Chowdhury, R. R., de Bremond, A., Ellis, E. C., Erb, K.-H., Filatova, T., . . . Kuemmerle, T. (2018). Middle-range theories of land system change. *Global Environmental Change*, *53*, 52–67. https://doi.org/10.1016/j.gloenvcha.2018.08.006

Networked Learning Editorial Collective (NLEC) (2021). Networked learning: Inviting redefinition. *Postdigital Science and Education*, *3*, 312–325. https://doi.org/10.1007/s42438-020-00167-8

Newen, A., de Bruin, L., & Gallagher, S. (2018). *The Oxford handbook of 4E cognition*. Oxford University Press.

Packer, J. M., & Goicoechea, J. (2000). Sociocultural and constructivist theories of learning: Ontology, not just epistemology. *Educational Psychologist*, *35*(4), 227–241. doi: 10.1207/S15326985EP3504_02

Plomp, T., & Nieveen, N. (Eds.). (2013). *Educational design research: An introduction*. SLO, Netherlands Institute for Curriculum Development.

Poston, D. L. (2015). Human ecology. In J. D. Wright (Ed.), *International encyclopedia of the social and behavioral sciences* (2nd ed.) (pp. 283–288). Elsevier.

Poquet, O., Kitto, K., Jovanovic, J., Dawson, S., Siemens, G., & Markauskaite, L. (2021). Transitions through lifelong learning: Implications for learning analytics. *Computers and Education: Artificial Intelligence*, 100039. https://doi.org/10.1016/j.caeai.2021.100039

Reed, E. S. (1992). Knowers talking about the known: Ecological realism as a philosophy of science. *Synthese*, *92*(1), 9–23.

Stokols, D. (2017). *Social ecology in the digital age: Solving complex problems in a globalized world*. Elsevier.

Valsiner, J., & Van der Veer, R. (2000). *The social mind: Development of the idea*. Cambridge University Press.

Vygotsky, L. S. (1987). *The collected works of L. S. Vygotsky: Vol. 1. Problems of general psychology.* Plenum.