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"Knowing in practice" in Posthumanist Practice Theory: A Cartography

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Abstract
Posthumanist Practice Theory has emerged in management and organisation studies in recent years. This approach entails de-centring the human subject, promoting the ongoing deconstruction of humanism. It also encompasses a critical reconsideration of knowledge to overcome anthropocentric, essentialist, and speciesist positions to offer new reflections on the crisis of the Anthropocene. The contribution provides a cartography of the concept of "knowing in practice" in posthumanist practice theory across the theoretical traditions that contributed to its development. By tracing the contribution of different theoretical traditions, the article shows how knowing and practising are not separate activities but interact and produce each other. Knowing emerges from practising due to becoming sensitive to the sociomaterial relationships involved in the practice, and practising is affected by knowing in a circular mutual relation. Moreover, in posthumanist practice theory, knowing in practice is an ethical process in which subjects constantly converse with the world and become with it.

Keywords
Posthumanism, Posthumanist, Practice Studies, Science & Technology Studies, STS, Organisational Knowledge, Organisational Learning, Knowing-in-Practice

1 Introduction

Conversations about critical posthumanism have emerged in management and organisation studies in recent years. This approach entails de-centring the human subject, promoting the ongoing deconstruction of humanism. Critical posthumanism, therefore, involves a repositioning of the human about other non-human entities and the non-living world. This repositioning also encompasses a critical reconsideration of knowledge to overcome anthropocentric, essentialist, and speciesist positions to offer new solutions for the crisis of the Anthropocene.

The posthumanist turn has given rise to a novel practice tradition that is mainly concerned with knowledge production and the connection between knowledge and practice: the posthumanist practice theory (Cozza & Gherardi, 2023; Gherardi, 2022; 2024; Parolin, 2022; Parolin & Pellegrinelli, 2024; Pellegrinelli & Parolin, 2023; Pellegrinelli, *forthcoming*). The posthumanist practice theory offers a novel interpretation of practice-based studies (PBS). Practice-based studies (PBS) constitute a comprehensive family of theoretical approaches that analyse social phenomena through the lens of practice (Reckwitz, 2002), thereby promoting a novel perspective on knowledge as knowing in practice (Gherardi, 2000).

This contribution aims to elucidate the concept of knowing in practice espoused by the posthumanist practice theory. To this end, it seeks to construct a cartography of social and organisational studies traditions that have contributed to this novel posthumanist practice-based conception of knowledge.

Practice-based studies (PBS) can be found in several different sociological traditions (Nicolini, 2012), including those associated with Marxism, Wittgenstein's linguistic turn, Heidegger's phenomenology, the North American pragmatist tradition, the social learning tradition, ethnomethodology, activity theory, the work of Giddens and Bourdieu, and ecological theories of cognition. Each of the aforementioned traditions focuses on differently on practice and employs specific methodological tools to analyse social phenomena (Nicolini, 2012). Despite their differences, they are unified by a fundamentally innovative approach to understanding and explaining social phenomena as dynamic and situated events, inviting researchers to consider practice as the unit of analysis (Gherardi, 2023).

The posthumanist critical practice-based approach considered in this article has its roots in a specific current of practice-based studies in organisational studies, originating from the work of Silvia Gherardi (Gherardi, 2019; 2021; 2022a; 2022b; 2023; Gherardi et al. 2024) and Davide Nicolini (Nicolini, 2009; 2012; Nicolini & Monteiro 2017) and continuing with the contributions of numerous other scholars, including - among others - Anders Buch (Buch & Schatzki, 2018; Buch et al. 2023), Attila Bruni (Bruni, 2005; 2014; 2023; Bruni et al., 2007; 2015), Silvia Bruzzone (Bruzzone, 2015; Bruzzone & Stridsberg, 2023), Michela Cozza (Cozza 2013; 2021; Cozza & Gherardi 2023a; 2023b; 2023c), Marcelo de Souza Bispo (de Souza Bispo 2016; de Souza Bispo & Gherardi, 2019), Francesco Miele (Gherardi & Miele 2018; Miele, 2023), Laura Lucia Parolin (Parolin 2011; Parolin, 2020; 2022; Parolin & Mattozzi, 2013; 2014; 2020; Parolin & Pellegrinelli, 2020a; 2020b; 2022; 2024), Carmen Pellegrinelli (Pellegrinelli, *forthcoming*; Pellegrinelli & Parolin 2023; 2024), and Assunta Vitteritti (Viteritti 2013; 2015; Rubini & Vitteritti 2023).

The practice-based tradition of knowledge conceives knowledge as 'knowing in practice' (Contu & Willmott, 2000a; 2000b; Gherardi, 2001; Orlikowski, 2002; Corradi et al., 2010). The 'knowing in practice' category explains and accounts for how professional competence is formed, mobilised and unfolded within situated social practices. Moreover, this conceptualisation contributes to process studies of the organisation (Langley & Tsoukas, 2010), and it is crucial for delineating an analytical model capable of understanding the contemporary transformation of work, where the value of products and services is increasingly connected to knowledge.

Posthumanist practice theory continues the practice-based exploration of social phenomena but is rooted within a relational onto-epistemology (Barad, 2003; Law, 2004) that privileges neither humans nor non-humans. This rootedness has inevitable analytical consequences concerning the application of the practical lens because it conceives of practices not as acts, actions, routinised behaviours carried out by human actors but as relational events, encounters, assemblages, interweavings between human and non-human entities (Barad, 2003; Knorr Cetina, 1997; Latour, 2005; Mol, 2002; Pickering, 1997; 2010; Suchman, 2007). In the posthuman approach to practices, practices are always at the centre of the analysis, but human actors are no longer their primary origin. Human actors are the effects of the sociomaterial practices (relations, encounters, assemblages, entanglements) in which they are involved. They are made practitioners because of the encounters and relations in which they participate.

In the context of posthumanist practice theory, Gherardi enriches the concept of knowing in practice with new nuances and identifies a novel critical perspective in the consideration of knowing and knowledge. She maintains that the very nature of knowledge as an activity undertaken collectively rather than as a purely cognitive phenomenon renders it unsuitable as a resource to be exploited for its commodification (Gherardi, 2024).

To explain her conception of knowledge in posthumanist practice theory, Gherardi (2024) presents the image of clay as a material representing knowledge's plasticity as a process. For her, the clay image evokes the connection between knowledge and knowing, suggesting that knowledge can be understood as both a product and a process. The transition from knowledge to knowing represents a shift from an epistemology of possession to an epistemology of practice. Secondly, the image of clay refers to the material and co-constructed nature of knowledge in the entanglement between humans and non-humans. It translates the posthumanist tension towards a narrative that decentralises the human in favour of a more balanced view of phenomena.

Three dimensions can be emphasised in the conception of knowing in posthumanist practice theory. The first, already present in PBS, is the consideration of knowledge as an activity within a practice context. "Knowledge" becomes "knowing in practice", a process conducted collectively rather than as a purely cognitive phenomenon confined to the individual mind. "Knowing in practice" elucidates the processes through which professional competence is formed, mobilised and unfolded within situated social practices. The second dimension underlines that "knowing in practice" is always entangled with materiality, with a symmetrical participation of humans and non-humans toward the course of action. This second dimension does not imply that humans are not engaged in the action; instead, it suggests that "knowing in practice" is inherently connected and intertwined with the world's materiality. The final dimension refers to ethics. The ethical dimension of "knowing in practice" overcomes the idea of knowledge as a mere human capacity to be exploited for the advancement of capitalism, repositioning it instead as a valuable resource for positive ends. In light of the pressing challenges of the Anthropocene, including the climate crisis and the fourth technological revolution, organisational studies must move beyond a narrow focus on knowledge as a mere capitalist commodity. Instead, knowledge and knowing must be repositioned as a vital resource for the survival of both human and non-human species on the planet.

The article aims to design the cartography (Braidotti, 2017) of the traditions that contribute first to the emergence of PBS "knowing in practice" and then the more relational, sociomaterial and ethical idea of knowing in the posthumanist practice theory. Each of the traditions mentioned in the article has constituted a fundamental element in the conceptualisation presented. The cartography is constructed through the examination of seminal texts that are central to the current PBS discourse (Gherardi, 2000;

2012; Gherardi & Miele, 2018; Gherardi & Nicolini, 2004; Nicolini, 2012; Parolin, 2006; 2011) and other resources pillars of each tradition.

The following constitutes a presentation of the article. The second paragraph provides an overview of the developments in organisational studies between the 1970s and 1990s. The paragraph outlines the emergence of Gherardi´s PBS conception of knowledge from studies that advanced a systemic, mediated, cultural, and socially constructed perspective on knowledge. The third paragraph presents Lave and Wenger's (1991) social learning theory and the concept of knowledge as a mutual constitution of actors, activities, and the world. The social learning theory played a pivotal role in developing the idea of knowing in practice and the concept of a community of practice within the context of PBS. The fourth section outlines the Science, Technology and Society (STS) reflection on knowledge, focusing on the role of materiality in the course of action. This tradition has significantly impacted the development of contemporary practice-based studies, particularly emphasising the role of non-human entities and the transformation of knowing in the context of technological entanglement. The fifth paragraph continues the reflection on knowledge and materiality, presenting the concept of sociomateriality in organisational studies. The concept of sociomateriality has assumed a pivotal position within the posthumanist practice-based understanding of knowing. The sixth paragraph presents a concise overview of the processual turn in organisational studies, as advocated by Ann Langley (Langly et al. 2013). This has led to a reconsideration of knowledge in a processual sense. This tradition reinforced the PBS theory's tenets and emphasised the view of knowledge as an ongoing process, open to a Deleuzian interpretation of knowledge. This latter perspective is pivotal to the posthumanist practice-based conception of knowledge. In conclusion, the seventh paragraph considers the impact of the neo-materialist and posthumanist turn in social and organisational studies, which has introduced the affective and ethical dimensions into knowledge management. The discussion-conclusion summarises the contributions of these traditions to the posthumanist practice-based concept of knowing and critically proposes the picture.

2 The debate on organisational knowledge toward a more system and socially constructed idea of knowledge

To reconstruct the cartography of the knowledge tradition of posthumanist practical theory through the complexity of MOS's learning and knowledge debate, we focus on works that propose systematisation. To our knowledge, we found a small instrumental book written by Silvia Gherardi and Davide Nicolini (2004) that has never been translated into English. However, as Gherardi and Nicolini's book is twenty years old, we will supplement their systematisation with other resources. Gherardi and Nicolini (2004) highlight three main phases of the debate on organisational learning and knowledge produced by organisations, which can form the starting point of our reflection.

2.1. The first phase of the debate, the 70's

According to Gherardi and Nicolini (2004), the first pivotal systematisation we need to consider in the first phase is the one proposed by Agyris and Schön (1978). The authors identified six different ways of understanding organisational learning based on different conceptualisations of organisation: organisation intended as a group, as a collective actor, as a structure, as a system, as a cultural system and as a political arena. According to Argyris and Schön's systematisation, the very concept of learning and knowledge strongly depends on how organisations are conceived.

The second significant contribution reported by Gherardi and Nicolini (2004) is by Shirivastava (1983), who proposes another debate reading to categorise different ways of conceiving learning. Shrivastava (1983) identifies four distinct types of organisational learning: learning as an adaptation to the environment, as an institutionalised experience, as developing the knowledge base and as sharing culture. In Shirivastava's systematisation, learning is not fixed but a form of knowledge that can take different shapes and emerge in various contexts. Knowledge is linked to the ability to react to changes in a turbulent environment related to routines and rules. Knowledge is also considered a system of correspondence between action and results, a stock of information as a common heritage of the organisation's members. Finally, it emerges from cultural elements of the specific belief system as competencies that guide action.

The third contribution to constructing a commune base of learning within MOS has been developed by Fiol and Lyles (1985), who considered organisational adaptation and organisational learning as two different processes, affirming that change implied in adaptation does not necessarily mean learning. According to these authors, organisational adaptation is a behavioural modification that can be measured by observing changes in the management systems, decisions, and the allocation of resources (lower level). According to Fiol and Lyles (1985), strategic management needs to develop methods to account for learning that is more than mere observations of changes. When situations are frequently unique, ambiguous and have different interpretations, a more sophisticated analysis is required to understand what happens on the cognitive level.

Finally, Huber (1991) proposes that organisational learning is related to four different constructs: knowledge acquisition, information distribution, information interpretation and organisational memory. Huber (1991) defined learning as a process in which an entity – a human, an animal, a group or an organisation – learns if it changes the range of its potential behaviours through its information processing. Following his systematisation, this information processing can involve acquiring, distributing or interpreting information. According to him, there is little cross-fertilisation or syntheses of works done by different research groups in different streams of the MOS debate, and organisational adaption and innovation could be improved if organisational designers knew more about how organisations learn and can be led to learn.

In examining the initial phase of the discourse on organisational learning and knowledge, it is evident that while Fiol and Lyles (1985) and Huber (1978) adopt a behaviouristic perspective, viewing organisational learning through the lens of classical behaviourism, Agyris and Schön (1978) and Shrivastava (1983) present a more nuanced and systemic understanding of the concept. These two authors are more prone to align to situated learning, which emerged in the 1990s, and represent a significant step towards a sociomaterial and processual understanding of learning and knowledge. It can, therefore, be argued that their work represents a precursor to considering knowledge in a practice-based and posthumanist practice-based lens.

2.2. The second phase of the debate, the 80's

According to Gherardi and Nicolini, the second phase of the debate was characterised by a differentiation in the discussion of knowledge between academics and managerial consultants. In this phase, the academic view on learning and knowledge clashed with organisational consultants' managerial vision of knowledge and learning. Indeed, during the 1980s, while an effort was made to systematise the literature on organisational learning by MOS scholars, numerous corporate consultants and managers of large companies began to deal with (and write about) knowledge and learning in organisations.

Their vision grew with the influential book by Peter Senge (1992; 2014), "The Fifth Discipline: The Art & Practice of The Learning Organization". In his seminal work, Senge introduces the "learning organisation" concept, which posits that companies and individuals can continuously adapt and grow in response to challenges through organisational learning. Senge proposes that five core disciplines can help organisations become more adaptive and innovative: systems thinking, personal mastery, mental models, shared vision and team learning.

As Gherardi and Nicolini (2004) point out, these new managerial studies made a semantic distinction, reversing the debate on learning in the organisation: from "organisational learning" to the "learning organisation". Thus, the debate on organisational learning was divided between the descriptive approach of academic research and the prescriptive approach emerging in business and consulting environments. The two approaches and communities, which attended the same discussion areas for a certain period, promoted different conferences and journals and separated their research interests (Gherardi & Nicolini, 2004). The prescriptive intent presented an organisational model that learns as an ideal to achieve.

Meanwhile, in the 80th, the descriptive approach gave rise to a series of organisational perspectives that changed the landscape of management and organisation studies and the consideration of knowledge and knowing. These new trends evidenced a shift from traditional, mechanistic views of organisations to more sophisticated, complex, and human-centric perspectives. One of the main traditions of the eighties was "organisational symbolism", which encompassed several trends that focused on the role of symbols, metaphors, and narratives in shaping organisational life. One of them was the tradition of organisational culture. From this perspective, Edgar Schein (1985) explored how culture influences organisational life through its symbolic elements. In his work on organisational learning, Schein (1985; 2004) highlighted how organisations create and transform knowledge. He posited that effective learning and knowledge management necessitate understanding the cultural and social dynamics intrinsic to organisational structures.

Another trend, within "organisational symbolism," was developed by Gareth Morgan (1986) to reflect on the MOS debate. Morgan proposed different images of organisation to narrate how organisational scholars conceptualised the organisational phenomena, such as the organisation-as-machine, organisation-as-organism, and organization-as-culture. By employing a variety of metaphors to examine organisations, he emphasised the idea that knowledge is not simply a collection of facts but rather a socially constructed phenomenon that is influenced by the organisational context, culture and interactions within that context (Czarniawska & Kostera 2024). In the same period, Karl Weick (1979) investigated the processes through which organisations construct meaning in the context of complex and ambiguous situations, employing the concept of sense-making. Weick put forth the proposition that the construction of knowledge is not a passive process; rather, it is a dynamic and socially constructed phenomenon. Organisations collectively create and negotiate meanings, subsequently informing their understanding and utilisation of knowledge. This perspective emphasised the social and collaborative aspects of the development of knowledge, which is a process that is not merely individual but also collective.

In the eighties, this last corpus of heterogenous descriptive tradition focused on observing and understanding phenomena related to knowledge, its use, its generation mechanisms, and its reproduction. This trend opened the path of a corpus of reflections that is helpful in building a new future, a more processual, sociomaterial, and relational perspective of knowledge in line with the posthumanist practice-based approach[1].

2.3. The third phase of the debate, the 90's

Finally, the third debate phase on organisational learning and knowledge, underlined by Gherardi and Nicolini, focuses on how knowledge is created and used within organisations (Gherardi & Nicolini, 2004). This phase is characterised by the emergence of the "knowledge management" label. *Knowledge management* is the systematic process by which organisations generate, acquire, organise, share and utilise knowledge to achieve their objectives and maintain a competitive advantage. It encompasses a variety of strategies and practices devised to effectively identify, capture, structure, value, and disseminate an organisation's intellectual assets.

[1] See Czarniawska (2012) for how organisational scholars discovered anthropology.

According to Gherardi and Nicolini, the term' knowledge management' became popular in those years, substituting for 'management of knowledge' (Gherardi, 2003). Academic interest shifted from how an organisation acquires knowledge to the best administration techniques. In doing so, the knowledge management debate described knowledge as a stock of know-how that the right tools and techniques can manage. According to Gherardi and Nicolini (2004), knowledge management literature avoided complexity by considering knowledge as information and considering a linear relationship between knowledge and action.

In the tradition of 'knowledge management', in the 1990s, Ikujiro Nonaka, together with Hirotaka Takeuchi (1995), developed the concept of organisational knowledge creation and elaborated the famous SECI model. This model describes the knowledge conversion process in organisations from tacit to explicit and vice versa. Nonaka and Takeuchi emphasised the importance of knowledge as a key resource for innovation and competitive advantage in organisations.

In the same line of knowledge management, Thomas H. Davenport and Laurence Prusak underlined key concepts related to the creation (Davenport & Prusak, 1998), sharing and utilisation of knowledge within organisations. They defined *knowledge* as a fluid combination of experiences, values, contextualised information and insights, which provides a framework for evaluating and integrating new experiences and information.

Another influential work on this line of thought is Peter Druker (1993): "Post-Capitalist Society", which examined the transition from an industrial-based economy to a knowledge-based society. Druker highlighted how academic scholars of knowledge management increasingly considered knowledge a resource, a utility, or a public good. Druker suggested considering contemporaneity as a 'knowledge society', a post-capitalist society where knowledge and competence have become resources that can be exchanged and sold, acquiring an economic value.

Many organisational scholars criticised this stream of literature because it exposed an objectifying and linear idea of knowledge and showed a slight interest in exploring the relationship between knowledge and power. For example, Frank Blackler (1995) proposed that knowledge is mediated, situated, provisional, pragmatic, and contested. Blackler's work highlighted that knowledge held within organisations is not a fixed entity; rather, it is a dynamic process frequently influenced by social and cultural factors. This viewpoint challenged the traditional, hierarchical approach to knowledge management and pointed towards a more fluid and socially constructed understanding of knowledge within organisations (Bruni et al. 2015). Within the organisational debate on knowledge at the turn of the century, Blackler still forms the basis of the social perspective of knowledge within MOS.

In conclusion, the three phases of the debate yielded two distinct positions regarding the conceptualisation of knowledge in organisational and management studies. On the one hand, there is a strand of conceptualisation of knowledge in a deterministic behaviourist key (Fiol & Lyles, 1985; Huber, 1991), cognitive key (Senge, 1992; Nonaka & Takeuchi, 1995; Davenport & Prusak, 1998) and capitalist key (Druker, 1993). Conversely, there has been a growing tendency to conceptualise knowledge in organisations as a holistic and systemic experience (Shrivastava, 1983), as a complex, human-centric, cultural, transformational activity (Schein, 2004), as a socially constructed and symbolically implicated phenomenon (Morgan, 1986), as a collectively created and negotiated process (Weick, 1979), and as a mediated, situated, provisional, pragmatic, and contested dynamic process (Blackler, 1995).

Concerning organisational studies, the second position illustrated constitutes the foundation and genesis of conceptualising knowledge as an activity in practice. Practice-based studies and posthumanist practice theory could rest on this conceptualisation. In the early 1990s, originating not from organisational studies but from education and learning studies, a new tradition emerged, giving PBS scholars a way to conceptualise knowledge as knowing in practice (Gherardi, 2000): the social theory of learning.

3 The social theory of learning: learning and knowing in practice

In 1991, Joan Lave and Etienne Wenger (1991) introduced the concept of situated learning, considering knowing as a process emerging from participating in a situated activity in a community of practice. According to the authors, learners inevitably participate in communities of practitioners, experimenting with the process of becoming full participants in a sociocultural practice. From their view, knowledge and learning have a relational character because the meaning of a learning activity is constantly negotiated and entails a matter of concern for people involved (Lave & Wenger, 1991). This represented a shift from the cognitive learning and knowing positions, which saw these activities as purely mental abstract processes. As pointed out in the previous section, the cognitive and behaviourist positions were those from which the managerial and organisational debate had taken the most.

Stephen Fox (1997) explained the differences in the conceptualisation of learning between traditional cognitive theory (TCT) and situated learning theory (SLT), pointing out the originality of Lave and Wenger's theory. According to Fox, situated learning theory (SLT) attempts to overcome the mind-body dichotomy and not view learning as an individual's problem but as a system and social practice product. It focuses on informal apprenticeship practices, studying everyday settings, particularly 'communities of practice' (Lave & Wenger, 1991), instead of the traditional institutional learning sites. For SLT, knowledge and learning are created in social interaction with the lived-in world and entail material aspects. Consequently, unlike the conventional cognitive approaches, SLT does not view knowledge as contained in the mind but as always contextualised and never objective. According to Fox (1997), professionally produced knowledge is always rooted in socially and materially situated contexts, and thus, he endorses SLT as a theoretical framework that better suits MOS.

Lave and Wenger (1991) point out that not everything can be taught, and an essential part of professional knowledge is based on and acquired only through a social process located in the concrete contexts of work. The concept of 'legitimate peripheral participation' marks the steps of the practitioner's journey into the apprenticeship and offers access to a nexus of relations. Peripheral participation is not a structured path in precise sequenced activities. Instead, it gradually introduces activities with different difficulty

levels, taking steps of responsibility. There is a recognisable form of how a novice is socialised to practice and the community of practices (Gherardi et al., 1998). The activities entrusted to the novice depend on the workflow needs. Still, at the same time, they respond to a recognisable pattern of gradual involvement and socialisation in the work practice: a 'situated curriculum' (Gherardi et al., 1998). A situated curriculum depends on the occurrences of the moment, but it still follows a graduality in involvement and responsibility for the activities.

Therefore, Lave and Wenger's theory on situated learning and the concept of legitimate peripheral participation reverse the traditional perspective by proposing focusing on learning processes 'without teaching' in place within work contexts. They upturn the idea of learning as individual achievement and the traditional way to consider knowledge as something external to the learner. According to Lave and Wenger, knowledge is instead conceptualised as the result of a process of production and legitimation within specific professional communities, what they call the communities of practice. Conceptualised as such, learning is not an activity dissociated from everyday reality and limited to specific domains; instead, it is an intrinsic characteristic of every social activity (Lave & Wenger, 1991, p. 35).

Therefore, according to scholars of this tradition, learning is a situated process that has to do with the person as a whole and her relationship with a social entity (community of practice) rather than being a matter of acquisition or appropriation of a codified corpus of knowledge. Learning has to do with constructing an identity that is linked to the professional competence recognised and legitimised within a community. Thus, professional identity and competence are interconnected elements generated by involvement and participation in specific social and work practices (Lave & Wenger, 1991, pp. 98-99). In this sense, knowledge is not viewed as a corpus separate from the knowing object but rather as actors, activities and the world mutually constituting each other (Ibidem, p. 33).

Situated learning theory focuses precisely on the social dimension of knowledge and professional knowledge by placing questions relating to how it is produced, reproduced, and transmitted at the workplace at the centre. According to this approach, knowledge does not reside in people's minds, and mental phenomena are social phenomena intended to be grounded within a social and material context. Learning is no longer something separate from the context of the action and work but is the effect of being in the world and participating in social practices. Therefore, the very concept of knowledge is modified by this approach (Gherardi, 2001).

Situated learning theory constitutes the second fundamental piece of the conception of knowledge as an activity in practice-based studies and, subsequently, posthumanist practice theory.

4 The contribution of STS to knowledge and learning

In the same years Leve was developing her social conception of learning, a trend that questioned the very concept of science was emerging: social studies on science and technology (STS). STS contributed enormously to renewing the concept of knowledge by studying concrete practices of knowledge production in the places assigned to the construction of science. These studies have focused on specific practices scientists use to decontextualise situated knowledge, transforming it into generalisable propositions (Latour & Woolgar, 1979). STS consider science a social process that constructs a specific kind of discourse (Latour, 1999; 2005).

The vocabulary used in these studies describes the scientific work as 'construction' or 'fabrication'. From the Latin verb *facere*, Knorr-Cetina (1981) proposes to use the term 'facticity', and Latour (1987) speaks of the fabrication of scientific facts and technical artifacts; both focus on the dimension of the social construction of knowledge and science (Gherardi, 2001). The epistemological terrain of this conception of science emerges in a convergence of different study traditions, united by opposing the positivistic logic at the basis of scientific knowledge. As Knorr Cetina argues, direct observation of scientific workplaces, primarily scientific laboratories, demonstrates the social determination of even the most technical content of science (Knorr-Cetina, 1983). Through the in-depth study of work practices in laboratories, STS developed an original approach based on the ethnographic study of work activities. As Michel Lynch (1993, p. 92) argues, the descriptions of scientific practices emphasise the contrast between their situated performance and the rational reconstruction in the experimental reasoning of scientific texts and research reports.

STS scholars highlight how the observed work practices follow different directions from the rational reconstruction to make a posteriori to justify the research process. According to this approach, scientific knowledge is not derived from discovery actions but is produced (manufactured) in situated practices of mobilisation, production and reproduction implemented by scientists. Studies that have dealt with the construction of a 'scientific fact' in the laboratory (Knorr-Cetina, 1983; Latour, 1987; Latour & Woolgar, 1979; Lynch, 2002) have highlighted those formalised rules, methods and procedures used in science are not sufficient to explain the work of scientists and to account for their results. These authors, interested in the social construction of scientific facts, also began to deal more systematically with the issues of technology and technological systems, defining an emerging multidisciplinary research field with the contribution of philosophers and anthropologists of science and technology (Sismondo, 2010).

The sociology of the translation approach, also known as the Actor-Network Theory (ANT), emerged in this context. The sociology of translation considers every 'entity' that does a job as composite and temporarily held together by translation processes. Therefore, even for the theorists of the ANT, 'the social' is an effect that is produced and studied by following the associations between human and nonhuman actors (also called actants) (Latour, 2005). According to Latour (2005), social dynamics result from the manifestation of materiality through which they unfold. Nonhumans are fundamental participants in each human course of action because they impact it, making a difference. Objects and other nonhuman entities are not passive but affect people by making them do certain actions.

STS has contributed to shifting the concept of knowledge from an individual cognitive approach to considering it a collective activity situated within specific working practices. Moreover, these studies brought to the fore for MOS and practice-based studies the importance of nonhumans in scientific work practice, highlighting the role of materiality in working and organising (Orlikowski 2007, 2010; Carlile et al., 2013; Langley & Tsoukas, 2010). As we will see, the consideration of technology in practice shows how for PBS and posthumanist practice theory: "knowledge is, first of all, embodied and embedded in technological practices and objects of everyday use, including the physical environment in which the practices are performed, which enables individuals, groups and communities located far away from one another to work together" (Gherardi & Miele, 2018, p. 13). STS was a fundamental contribution to posthumanist practice theory's conception of knowing.

5 Sociomateriality and knowledge

The STS provided a significant source of inspiration for developing a new concept in the MOS and in PBS, which emerged in the mid-2000s and constituted a fundamental element of the subsequent posthumanist turn: sociomateriality.

Considering technology as technology-in-practice required accepting that technologies were inseparable from their use. The use of a specific technology is permanently embedded in a field of relationships with other tools and other practices. Therefore, pondering technologies as social practices meant studying them in their contexts of use, adopting an approach that views technologies and social relations as a system characterised by relations of mutual co-construction.

In 1996, Lucy Suchman (1996) argued for an intimate relationship between the work setting and the structuring of activities in coordination centres. Suchman (1996) was interested in coordination centres as 'technologically dense' settings, i.e., places where technology (telephones, radios, monitors, etc.) is indispensable for staff to carry out their daily activities. Suchman studied the daily work of air traffic controllers in a United States airport and analysed how the control tower staff work: how they communicated with each other, coordinated activities, used technologies and acted during emergencies. Her work showed that technologies and objects have some predefined roles, but their use is always contextual, considering their importance for the actors in specific situations (Suchman, 1996).

All these reflections on technology and work practices converged – in MOS – around the concept of sociomateriality. Wanda Orlikowski (2006; 2007; 2010) was the first to use sociomateriality – without the hyphen – to underline and demonstrate the role of materiality as an integral aspect of organisational activity (Orlikoswski, 2010). She rejected the ontology of separateness, which views technology and humans as essentially different and separate realities, positing a relational ontology (Law, 2004; Barad, 2003) instead. Relational ontology does not privilege humans or technologies but focuses on their constitutive entanglements enacted in practice (Barad, 2003; Knorr Cetina, 1997; Latour, 2005; Mol, 2002; Pickering, 1995; Suchman, 2007). Orlikoswski identified the roots of relational ontology in Actor-Network Theory contributions (Callon, 1986; Latour, 1987) and the work of Barad (2007). Their relational view rejects the idea of independent realities with well-defined properties waiting to be interpreted (Orlikowski & Scott, 2014) in favour of recognising a relationship and a mutual determination between subject and object (Gherardi, 2019).

In the ongoing debate on sociomateriality, Jones (2014) distinguished between two forms of sociomateriality: weak and strong sociomateriality. Strong sociomateriality addresses all of the concepts that Orlikowski (2010) detailed on sociomateriality, namely materiality, inseparability, relationality, performativity, and practices. This perspective emphasises the situated detail of recurrent local practice and the temporally and spatially extended networks of sociomaterial interaction that give rise to these practices. The weak version of sociomateriality employs only some of Orlikowski's concepts selectively (Jones, 2014). Weak sociomateriality concentrates on the relative stability and similarity of practices carried out within a specific context, some of which may be regarded as relatively enduring and independent. Indeed, strong sociomateriality draws primarily on the work of Barad (2007), Latour (2005) and Law (2004), whose approach is based on a fully relational ontology, whereby entities only exist concerning other entities.

Beyond the differences between types of sociomateriality, all the practice elements become decisive when enacted in a material network of connections. Assuming the strong Orlikoswski's perspective on sociomatriality means giving equal importance to all humans, nonhumans and more-than-humans involved in a practice. From the standpoint of posthumanist practice theory, Gherardi and Miele (2018) underline that the strong sociomaterial positioning conceptualises knowledge as embedded within sociomaterial relations. Knowledge becomes social, material, and performative (knowing) and cannot be separated from the social (and work) practices in which it occurs. Therefore, practices emerge from the agency between actions, events and processes and manifest as contingent expressions of the connections between the elements involved in the practice's network. In this way, creativity, innovation and new knowledge are processes intrinsically manifested in the practices through the relational bonds involved in the process. Thus, knowledge (and knowing) also develops outside predefined areas and times and entails any social and work activity.

6 Knowing in the processual turn in MOS

Closely related to Orlikoswski's relational ontology is the process ontology adopted in the late 2000s by the process perspective in organisational studies (Monge, 1990; Langley & Truax, 1994; Sonnentag, 1998; Steyaert, 1997; Langley & Tsoukas, 2010; Langley et al., 2013). The processual perspective of organisational studies proposed by Ann Langley and colleagues (2013) directs attention

towards how phenomena emerge, flourish, evolve, or decline over time. Process studies elucidate the part played by tensions and contradictions in propelling patterns of change and demonstrate how interactions across levels contribute to change. Furthermore, they may reveal the dynamic activity that underlies the maintenance and reproduction of stability.

Processual studies draw strong inspiration from the philosophy of Alfred North Whitehead and, in particular, his work 'Process and Reality' (Whitehead, 1929). 'Process and Reality' proposes the metaphysics of process, a radical and innovative view of the world where relationships, change and becoming are central to understanding reality. Following Whitehead, Langley and colleagues (2013) emphasise the shift to an: "ontology of process based on the metaphysics of process, in which the world itself is fundamentally seen as consisting of processes rather than things. In this view, entities (such as organisations and structures) are nothing more than temporary instantiations of ongoing processes, continually in a state" (Langley et al., 2013, p. 5).

The core tenet of Whitehead's process philosophy is the primacy of becoming over being. This contrasts with the prevailing view in Western philosophy, particularly the Aristotelian tradition, where being is regarded as primary and change is viewed as secondary or derivative. Process philosophy challenges this conventional wisdom, asserting that becoming, continuous change, and transformations are the fundamental characteristics of reality. It posits that the entities or beings we perceive as fixed and enduring are, in fact, transient phases within an ongoing process of evolution.

With the process perspective in MOS, the concept of knowledge also changes. The perspective of knowledge as a stock of know-how is superseded, and knowledge as a processual, relational and contextual perspective becomes widespread. Langley's perspective emphasises the fluid and evolving nature of knowledge, focusing on its enactment through individuals' continuous interactions and practices within organisational contexts. The primary debate in the MOS is still rooted in what has been described as metaphysics of substance or variance theories (Mohr, 1982); however, process studies are increasing in importance, highlighting the situated and mediated nature of any organisational phenomenon (Langley & Tsoukas, 2010) and constitute another step towards a posthumanist conception of knowledge.

Whitehead's philosophical grounding of processual organisational theories not only serves as a reference to the processual nature of PBS but also forms a significant connection to their posthumanist turn. This connection is rooted in the Deleuzian theoretical conceptions, which are the foundation of posthumanist practice theory. The intersection of processual studies and posthumanist practice-based studies is a fascinating aspect of our field, both being part of a broad anti-Cartesian philosophical tradition that spans from Spinoza to Deleuze via Whitehead, Bergson and Foucault.

7 New materialism, posthumanist turn and knowledge

The perspectives of relational and processual ontologies meet in the recent position of new materialism. The 'new materialism', a theoretical and practical 'turn to matter' in social sciences, proposes an ontology that does not separate nature from culture and focuses on the world's materiality (Fox & Alldred, 2015; 2016). The new materialistic perspective reflects a monistic vision, eliminating the division between a 'physical' and 'abstract' domain with social structures and cultural products. Since everything comes from the same substance or matter, everything constantly becomes and transforms.

According to Fox and Alldred, the new materialist perspective is based upon three assumptions. First, the material world is in constant flux (Barad, 1996; Coole & Frost, 2010, p. 29; Lemke, 2015); therefore, the matter is not a stable entity but relational and constantly changing. Second, 'nature' and 'culture' are parts of the continuum of materiality; as Rosi Braidotti states, 'what comes to the fore instead is a nature-culture continuum in the very embodied structure of the extended self [...]' (Braidotti, 2013, p. 8). Third, 'agency' pertains to humans, nonhumans and inanimate (Braidotti, 2013; De Landa, 2006; 2016; Latour, 2005). Indeed, according to Latour, "[W]e are going to accept as full-blown actors' entities that were explicitly excluded from collective existence by more than one hundred years of social explanation" (Latour, 2005, p. 69).

New materialism follows the trajectory of a posthumanist perspective that "focuses on the critique of the humanist ideal of 'Man' as the allegedly universal measure of all things" (Braidotti, 2019, p. 32), offering alternative definitions of 'human' (Braidotti, 2013). Posthumanism is typically employed to signify the conjunction of posthumanism and post-anthropocentrism within an economy of advanced capitalism (Braidotti & Hlavajova, 2018). This results in a critique of the humanist ideal of Man and a rejection of human exceptionalism, thereby establishing a species hierarchy (Braidotti, 2013).

Reflecting on the posthumanist challenges within the MOS, Gherardi and colleagues (2024) highlighted four central aspects of this theoretical perspective that affect posthumanist practice theory and the idea of knowing in practice. The first is the consideration of subjectivity as something that overcomes essentialism and the division between human and nonhuman for a conception of subjectivity in continuous becoming: "The posthuman subject is always raced, gendered, and otherwise multiple identified" (Gherardi et al., 2024, p. 6).

The second is overcoming the idea of materiality as an 'inert substance' towards the vision of a living, vibrant matter (Bennet, 2010) or substance (Deleuze & Guattari, 1987), of which we are all apart. This view recognises how nonhumans play a crucial role in natural cultural practices, including social and scientific ones (Barad, 2007). Matter is a generative force no longer opposed to meaning; material reality and meanings co-constitute themselves through an iterative process of becoming (DeLanda 2006; Parolin & Pellegrinelli 2024).

The third is recognising that the entanglement of self and others posit feminist ethics at the centre and reconfigures responsibility as an ongoing responsiveness. Ethics is important not as a moral imperative but as the capacity to respond to others and the world responsibly and caringly (Cozza et al., 2024; Pellegrinelli & Parolin, 2024). Finally, the posthumanist positions claim for a reconsideration of the researcher as materially involved in research fields, and thus, it calls for a revision of research practices

in a post-qualitative sense (Cozza & Gherardi, 2023; Pellegrinelli & Parolin, 2023). As we will see in the discussion, all these aspects enrich the concept of knowledge and "knowing in practice" in posthumanist practice theory.

8 Discussion and conclusion

Many voices have contributed to making the clay of knowing perspective in the posthumanist practice theory. The path toward a posthumanist, relational, sociomaterial, ethical view of knowing in practice is dynamic, carsick and trans-disciplinary. To propose a complete systematisation of the debate was not the aim; however, this article offered a way to read the path of the development of a PBS perspective on knowledge and learning toward a posthumanist consideration of knowledge, showing how multiple theoretical traditions enriched the debate and helped to construct a more nuanced and contemporary idea of knowing in practice in MOS debate.

The first step towards a posthumanist conception of "knowing in practice" started within those movements favouring a conception of knowledge as socially constructed, cultural and negotiated. Within this panorama, the concept of knowing-in-practice, born in 2000, presented itself as a strong novelty. The term 'knowledge' moved to the verb 'knowing' as a collective activity and overturned the cognitive, behaviourist and commodified conception of knowledge towards a vision of knowledge as learning by being in the world.

The concept of knowing in practice drew much theoretical support from the social learning theory of Lave and Wenger (the second step we highlighted). It consisted of considering knowing and learning as an activity and participation in practice (Lave & Wenger, 1991). In Lave and Wenger's theorisation, the knowing passed from an individual perspective to a collective one: learning and knowing became social activities because they emerged and thrived in a community of practice. Knowledge was conceived as an activity not enclosed in the mind and produced through cognitive operations. Suggesting the situatedness of knowing and learning, Lave and Wenger opened the path to the third step of knowing conception: how knowing is embedded in materiality.

In the third passage underlined in the article, knowing in practice is enriched and strongly implied by materiality. Materiality has gained centrality in the discourses about knowledge in the last 30 years, primarily through STS theorisation. STS massively contributed to renewing the concept of knowledge by studying concrete practices of science and knowledge production within the places assigned to it.

STS scholars pointed out the embeddedness and interrelatedness of actors, artefacts and situated contexts as essential work features. More significantly, this body of research highlighted the contribution of nonhumans to the social world (Latour, 2005). This interest in materiality and nonhumans has been taken up in the conception of knowing in practice, opening up interesting research fields such as the object's ethnography (Bruni, 2005; Parolin, 2010a; 2010b; Parolin, 2014). Moreover, more generally, in organisation studies, this interest has converged towards the theorisation of sociomateriality, which constituted a fourth element of enrichment and transformation of the concept of knowing in practice in a posthumanist key.

With sociomateriality, practice-based studies overcame the dualism between social and material within sociomaterial practices. This approach suggested the displacement of the human subject as the central seat of agency. Indeed, it proposed and recognised the social as material and the material as social. This positioning has also blurred the distinction between practising and knowing, proposing that they are an ongoing, incremental, distributed process that cannot be separated from the reproduction of social practices (Gherardi, 2019). Knowing is an activity that is collectively performed while working, organising and innovating.

Nevertheless, knowing is no longer a characteristic that pertains only to humans. Actor-network theory suggests that objects and other material entities modify how they act in the world because of their encounter with other entities (Parolin & Pellegrinelli, 2020a; 2020b; 2024). Thus, learning and knowing must be conceptualised, taking the human actor's centrality away.

Sociomateriality, with its relational ontology, constituted a fundamental shift in the conception of knowing in practice from a posthumanist perspective. At this point, the shift towards a posthuman view of knowing in practice is completed by the adherence to a processual (as well as relational) ontology and feminist critical posthumanism. Here, the dimension of subjectivity in becoming proposes an idea of knowing as becoming in connection with the material world. We noticed, as Gherardi (2009, p. 64) suggested, that knowing and practising are not separate activities but interact and produce each other. While practising, human and nonhuman actors become sensitive to encounters with other entities (other human and nonhuman actors) (*see* Parolin & Mattozzi 2013; 2014; 2020; Mattozzi & Parolin, 2021). Thus, in posthumanist practice theory, knowing emerges from practising as the result of becoming sensitive to the sociomaterial relationships involved in the practice, and practising is affected by knowing in a circular mutual relation.

Moreover, this conception of knowing as becoming is configured as an ethical process in which subjects are engaged in constant conversation with the world in the discovery of their many selves. At the heart of this vision is feminist relationality as a way of knowing (Cozza & Gherardi 2023a; 2023b) in relation to others always having a positive recognition of difference. Knowing is ethical because it is a process that implies the response-able relationship as a way of attuning to the other and with the other becoming. This conceptualisation rests on the opposite of the utilitarian perspective of knowledge as a human resource to be exploited for capitalist advancement that is leading humanity to ruin.

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