Chapter 16
Rethinking the Material, the Embodied and the Social for Professional Education

> I don't think that that's [interviewing] a difficult skill. The thing that I think that most – like pharmacists who haven't done it, that's one of the most daunting things that they do at first, is going into someone's house and interviewing them. But after they've done it for a while, the hardest skill is how to get out of the house because the patient's there and they want you to stay there forever and have two thousand cups of tea and lots of biscuits (laughing). So sometimes it's a very – and it's an important skill to learn how to get out. How to say 'the interview is finished now, I've got to go'. (Pharmacy Lecturer)

Evidence from cognitive sciences, psychology, neurosciences, anthropology, cultural studies and many other domains shows quite plainly – human cognition and behaviour exhibit extensive sensitivity to context (Boivin, 2008; Robbins & Aydede, 2009; Smith, Barrett, & Mesquita, 2010; Streeck, Goodwin, & LeBaron, 2011; Valsiner & Rosa, 2007). This includes the *internal* context created by other processes within the human body and brain (e.g. movement, mood, pain, feeling), the *external* physical things and surroundings and the immediate social environment and culture. In contrast, when it comes to education, it seems that abstract and decontextualised theoretical knowledge and disembodied ways of thinking are often favoured. This fracture between how people really *think* and how they are *taught to think* creates a number of serious challenges. One extreme is that students simply do not transfer what they learn in educational institutions to the tasks encountered in workplaces and everyday settings (see Chap. 6). Another extreme is that people, including scientists, become victims of 'the essentialism error' (Smith et al., 2010). That is, they tend to look for, and focus on, certain universal mechanisms, but fail to see and appreciate how these mechanisms are influenced by context.

Extensive evidence shows that many phenomena encountered in the world and in professional work – from genes and diseases to daily social life and culture – are context-sensitive and dynamic processes. Absolutist thinking simply does not work, and developing sensitivity to social and material contexts and awareness of one's own body and mind are emerging as important educational tasks. But how do the social, the material and the embodied enter professional knowledge work?

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In this chapter, we explore more deeply some of the ways in which the material, the embodied and the social are intertwined with professional epistemic practices – knowledge, action and learning – and in particular, ways in which they are enmeshed with professional epistemic games. Specifically, we argue that *professional knowledge work and knowledgeable action are constitutively entangled with embodied practices in the material and social worlds*. Therefore, careful attention to the roles of matter, the human body and social others in situated professional work helps us to understand how to design productive activities and environments for learning professional knowledge and skills. What we care about most is how to create opportunities for students to learn professional knowledge and skills that are simultaneously rich in characteristic ways of knowing and grounded in characteristic embodied, material and social experiences of authentic professional work.

We start this chapter by continuing our discussion of the examples from the Pharmacy Practice course introduced in the previous chapter. In Sect. 16.1, we illustrate how teachers tackled the challenges of creating productive learning experiences for teaching pharmacy practice knowledge and skills, by designing learning tasks that focus on characteristic ways of knowing and acting in the pharmacy profession. They encountered challenges creating suitable, sufficiently authentic social and material environments for such learning, and this opens up some questions related to the social, the material and the embodied nature of professional actionable knowledge. We explore this topic in the rest of the chapter. Specifically, Sect. 16.2 discusses how the material and the social are intertwined with professional actions and cognition. Section 16.3 then explores some dimensions of 'the material' and 'the embodied' knowledge and knowing that are constitutive of professional epistemic practices. Section 16.4 then turns to some dimensions of 'the social' knowledge and knowing. Section 16.5 returns to the question of mediation, which we explored earlier (Chap. 8) and discusses how knowledgeable action is mediated by the social, the material and the embodied. Section 16.6 concludes by discussing some implications for teaching and learning. It specifically draws attention to a central role of professional capacities to create epistemic tools and artefacts for one's own situated knowledgeable action – a topic that has received very little attention in professional education and one we return to at the end of the book.

16.1 Epistemic Games in Course Designs: Some Empirical Illustrations

16.1.1 Epistemic Games and the Material and Social Worlds

The medication management review and many other epistemic games that are played in professional workplaces are weaving games which are played in an ongoing interaction with the material and social worlds. They often proceed

simultaneously on many levels, drawing on different kinds of knowing and aspects of knowledgeability (see Chap. 4, Table 4.2). This creates a significant difficulty when it comes to designing authentic tasks in higher education settings. How best can one create learning experiences that help to develop capacities for such epistemically dense work? Does learning really need to proceed in all directions at the same time?

In our pharmacy observations, this challenge was tackled by the teachers through a mixture of lectures that introduced different topics, tutorials that analysed cases and weekly externships accompanied by structured activities guiding students to explore different aspects of pharmacy practice. The tutorial description from the course outline documentation explains this relationship between the therapeutic knowledge, the learning processes of pharmacy practice and the enactment of this knowledge in workplace settings, as follows:

> The tutorials are designed to help students integrate communication skills and therapeutic knowledge in order to solve the *types of problems* they are likely to encounter as a practicing pharmacist. The tutorials will be run in conjunction with the externship and students are encouraged to utilize externship placements to practice the material/processes discussed in tutorials. (Pharmacy Practice course outline, emphasis added)

Most usefully, this blending of different teaching and learning modes nicely illustrates the fact that mastering epistemic devices and epistemic games in professional pharmacy courses is a more universal skill than the ability to apply specific kinds of therapeutic knowledge for specific problems. The description continues:

> The tutorials will be conducted in a way that emphasises *processes* to allow students to practice as a pharmacist. This process will incorporate information gathering, information processing and information delivery. *Not all topics in therapeutics will be covered* in tutorials, but by the end of the semester students *should be able to apply these processes to any situation* that arises in practice (clinical interventions and medication reviews). (op. cit., first emphasis is original, others are added)

In short, learning to play epistemic games – which the pharmacy teachers simply called 'processes' – develops the students' capability to apply learnt propositional knowledge to 'types of problems' and enact learnt ways of thinking and doing within 'any situation that arises in practice'. Further, the tutorial handbook gives an insight into three other features of professional problem-solving and knowing. It explains:

> Many tutorials will be conducted over two sessions. In the first session, the focus of the tutorial should be on gathering and processing information. Prior to the second session for the case, students are expected to further research the case using a *variety of resources* (*including primary references where relevant*) and *document* their findings and recommendations (i.e., written information delivery). Findings and recommendations should be *referenced and prioritised*. <...> In the second session for a case, the focus should be on processing information and delivery of information (*written and verbal communication with medical practitioner and/or patient*). For example, students will be required to role-play a face-to-face case conference with a medical practitioner using their documented findings and recommendations as the basis for the case conference. Students will also be required to role-play a counselling session with a patient *using written information to*

> *support their counselling* (e.g. CMI [Consumer Medicine Information leaflets], Self Care Fact Cards). (Pharmacy practice: tutorial and externship handbook, emphasis added)

First, professional problem-solving is a dynamic, unfolding process, and different ways of knowing are integrated at different stages of inquiry. While 'gathering' focuses on ways of knowing that draw upon various sources, 'delivery' focuses on discursive ways of knowing.

Second, knowledge is created in collaboration and interaction – problem-solving is woven into trans-professional and public discourse games, such as case conferences and counselling, involving the patient, the doctor and other health professionals.

Third, various resources and written information are firm and explicit aspects of this professional knowing and problem-solving: information infrastructure, material–inscriptional devices and inscriptional artefacts, as well as their production, are fused throughout this professional knowledge-making process.

The terms 'prioritise' and 'reference' sit side by side in this description. The first of these terms reflects an expectation that the student will be able to make sensible pragmatic decisions in an 'ill-structured' situation. The second term conveys a firm belief that these pragmatic decisions are not arbitrary – evidence and rigorous defence of recommendations are seen as a natural part of professional pragmatic thinking.

These problem-solving and discourse games are sufficiently independent of each other to be learnt separately, before weaving them into a more complex game. This more complex game is partly an individual mental activity of identifying issues and finding solutions and partly a collaborative discourse game. Thus, the necessary skills can be partly 'unwoven' and learnt skill by skill:

> In first semester, we focus less on the communication with the doctor and more on *just identifying the problems*. And in second semester, we hope that they can find the problems. It's more about *how you communicate those problems*. (Pharmacy Lecturer)

16.1.2 Designing Environments for Learning Epistemic Games

Teaching 'process knowledge' can be a difficult task, but assessing it can be even more difficult.

> . . . it takes 2½ full days to get them all through this OSCE exam.[1] It's insane the amount of logistics that you have to do because they all have to start at different times. <. . .> So we had to have 10 examiners and they all go from station to station. It's like full on. (Pharmacy Lecturer)

[1] OSCE – Objective Structured Clinical Examination.

This difficulty is not just because it is a 'logistical nightmare', but because playing professional epistemic games involves space, time and the body. When knowledge and skill involve all three, one needs real time, and (something close to) real bodies and material spaces (environments) for learning, enacting and assessing those skills. In short, the constitutive entanglement between knowledge, matter and the body, involved in knowledgeable action that unfolds through space, time and movement, is a critical problem for the design of learning environments in higher education.

How should such learning environments be designed? Higher education generally tends to overemphasise *language and communication* as the main skill involved in such processes – space and the body are often overlooked. Language and flexible use of other forms of symbolic expression are important, but are not everything. One pharmacy teacher explained, in an unexpected way, why carrying out a medication review in the patient's home can be a complex skill to learn (see also the quote at the start of the chapter):

> Interviewer: And why did you say it [interviewing in the patient's home] may be daunting for them?
> Lecturer: Just because they've never walked into – they've never actually been in their patients' houses before.
> Interviewer: So just the place is different?
> Lecturer: Just the place is different, yeah. It's just something that they're – it's out of their comfort zone. (Interview with Pharmacy Lecturer)

Matter, and material and social space – what is often simply called 'context' – is not some kind of container that can be easily detached from the 'essence' of knowledge and problem-solving. It is an integral and fundamental aspect of this knowledge and knowing. The fine-tuned sensitivity of the pharmacist to the material context is at the core of making sensible professional decisions:

> Now sometimes you could treat something by using an injection but it's not as convenient – so it's not wrong because it would still treat the patient's disease but it's not as practical because the patient's in a home environment. <. . .> So that's the thing that they [students] – one of the problems that they have is they'll read it in the book and they're like 'that sounds alright' and they'll write that down without thinking about 'can this person really use that [syringe]?' (Pharmacy Lecturer)

Authenticity, as another lecturer pointed out, cannot be reduced to words but also involves bodies and actual situations, and any such reduction could have severe implications for a student's capacity to conceptualise an encountered problem:

> Also they're doing it [exam] as if it's a role play but there's no acting in the role play. So you could have another female member of staff pretending to be an old male doctor. So it's not authentic in that sense. It's authentic in terms of the *words* but not in terms of the *actual situation*. If our students were actually put with a more authentic situation, it could be easier for them to *conceptualise* the issue. It could even be the case that they're role playing with a patient, and the patient they're role playing with is a different gender to the patient. (Pharmacy Lecturer)

Further, would it be possible for students to infer relevant facts about the social and physical environment of a patient's home merely by seeing the boxes with the

medications that are usually used as substitutes for the patient's home environment in these role plays? Of course, an interview involving a pharmacy teacher who pretends to be patient is neither a real social practice nor a real material practice, and boxes with medications are not the authentic material and social environment. In this sense, 'role play' pedagogies have an inherent limitation when it comes to creating authentic professional experiences, as they rarely reproduce a sufficient range of epistemic affordances and practical contingencies of the kind one finds in the natural environment.

Why do university courses still try to create such pseudo-authentic environments and even tasks that involve situations that do not exist in the real world? There are several answers to this.

First, while epistemic games may not be the same as well-rounded social and material practice, they nevertheless are epistemic practices that play important roles in 'cognitive apprenticeship'. They make visible some of the habits of mind that would otherwise remain hidden and implicit in fluent expert work. This articulation of thought and various elements in the situation become particularly important when practice is an epistemic practice that couples *actions of mind* – which may not be explicitly expressed in material or discursive forms and moves – with *actions in the social and material worlds* – that are made explicit in discourse and artefacts.

Second, as we noted in Chap. 15, *work* and *learning for work* are not necessarily the same kind of practice (see Sect. 15.6). They are related, but not the same: the latter weaves in an additional game – we might call it a 'pedagogical game' or 'learning game' – and additional tools (learning tools) that are specifically created and used for *learning for transfer* (of knowledge and ways of knowing). Like most tools, they are artificial devices that prove to be effective for a specific purpose, i.e. for learning.

Third, epistemic games are not hard-wired to specific situations and contexts; they are enacted within, and have value across, contexts. Learning to recognise relevant situations, tweak more universal tools and weave professional games across diverse situations are fundamental to professional vision and flexibility.

Fourth, some epistemic games are played not because of their surface resemblance to the professional practice, but because of their ability to convey professional values and habits of mind. For example, the introduction of the case conference into the medication review process is one such game (see Sect. 15.5). The teachers explicitly acknowledged that this game is not common in pharmacy practice, but it is important to the pharmacy profession and it communicates professional values. It embodies the view that pharmacists and doctors should work in teams if they are to achieve better health outcomes.

> . . . at university, we still want to train the students to be able to talk to the doctors because we think in the future, perhaps, there may be a better funding model for that. But also it's still a good skill to have regardless of whether it ever gets paid for or not. (Pharmacy Lecturer)

Almost all the teachers we interviewed said something similar – they are trying to equip students with knowledge, skills and dispositions for better future practices.

For example, preservice teachers, in our studies, were often taught to use various innovative pedagogies and technologies in their teaching – even though their university lecturers were well aware that such innovative teaching is not seen as a core capability in current workplace settings.

16.2 Actionable Knowing as Embodied Social Practices in the Material World

How are knowledge work and knowledgeable action intertwined with embodied *material practices* in the physical world and with *social practices*?

> . . . thinking, or knowledge-getting, is far from being the armchair thing it is often supposed to be. The reason it is not an armchair thing is that it is *not an event going on exclusively within the cortex or the cortex and vocal organs*. It involves the explorations by which relevant data are procured and the physical analyses by which they are refined and made precise; it comprises the readings by which information is got hold of, the words which are experimented with, and the calculations by which the significance of entertained conceptions or hypotheses is elaborated. *Hands and feet, apparatus and appliances of all kinds are as much a part of it as changes in the brain*. (Dewey, 1916, pp. 13–14, emphasis added)

Cultural contexts, social situatedness, material artefacts and other contextual cues found in workplaces and learning places – in addition to the biology of the human brain and body – are commonly acknowledged as entities that have an impact on human thinking, learning and action. However, they have not always been seen as *constitutive parts* of knowledge, knowing and action or – in the case of the human brain and body – as being at the very core where thought originates. As Damasio (2012) asserts, the construction of a conscious mind – 'the self-as-knower' – depends on a far more basic 'protoself' and 'the self-as-object'.

> The unsung sensory portals play a crucial role in defining *the perspective* of the mind relative to the rest of the world. I am not talking here about the biological singularity provided by the protoself. I am referring to an effect we all experience in our minds: having a *standpoint* for whatever is happening outside the mind. This is not a mere 'point of view,' although for the sighted majority of human beings, the view does dominate the proceedings of our mind, more often than not. But we also have a standpoint relative to the sounds out in the world, a standpoint relative to the objects we touch, and even a standpoint for the objects we feel in our own body. (Damasio, 2012, p. 210, original emphasis)

How are the material and social intertwined with actions and thought (cognition) in professional work? To start, we approach this question by drawing on two related lines of thinking: (a) socio-material organising of action and (b) socio-material organising of cognition.

16.2.1 Socio-material Organising of Action

Revisiting studies of how everyday organising is bound up with materiality in organisational settings, Orlikowski (2007) observes that there are two common perspectives on how technologies and other material affordances shape, and are shaped by, human practices. She calls them the 'techno-centric perspective' and the 'human-centric perspective'. *The techno-centric perspective* takes a functional or operational approach. Its main focus is on how material tools and arrangements have an impact on human organising. From this perspective, technological and other tools are generally determined by their materiality, and their function in human activity is generally predictable, 'black boxed' and exogenous to human intentions and actions; thus, they evolve rather independently of users, contexts and the situations in which they are used.

The human-centric perspective focuses on human interpretations and dynamic interactions with tools and other material arrangements. This approach acknowledges that meanings assigned to technological tools and other material arrangements are shaped by history, culture, social contexts, human interests and other situational configurations. Thus, the ways in which people engage with these tools – and other material arrangements – are generally not determined by what the tools (etc.) are. How they enter into and shape human thinking and action is primarily the result of human sense-making, rather than materiality.

Orlikowski notes that some dynamic social theories have acknowledged that humans and their technological and material environments mutually shape each other. Nevertheless, these theories presuppose an ontological separation of humans and nonhumans: they interact and shape, but are still seen as entities independent from each other. In contrast, Orlikowski argues[2] that material and social, nonhuman and human, are *constitutively entangled* in everyday human organising.

16.2.2 Socio-material Organising of Cognition

A similar argument about the constitutive intertwining of human cognitive activity with culture, tools, contexts and dynamically emerging situations is also familiar in some areas of writing about human knowing and learning (e.g. Goodwin, 2005; Malafouris, 2013; Säljö, 1995).

As Grasseni (2010) puts it, there is a 'unity of cognitive and operative aspects' (p. 10). Technology, knowledge, culture, practice and learning come together in the notions of educating professional vision and skill.

[2] She draws on theoretical work on 'actor–networks', 'sociotechnical ensembles', 'the mangle of practice' and other similar approaches that have roots in science and technology studies (STS). Some of these ideas were introduced in Chap. 5.

> . . . skilled practices literally shape the way we look at the world. Participating in a richly textured environment, full of objects, images and body patterns, structures and guides our perception tacitly and implicitly. (Grasseni, 2010, p. 11)

There is a relational dynamic – a deep entanglement – between vision as skill and skill as vision:

> The notions of *taskspace* (Ingold) and *worldview* thus converge on the issue of practical understanding, achieved locally through material and social learning experiences. (loc. cit., original emphasis)

In this 'equation' material things and action schemes – historically and situationally co-constructed around those things – are usually conceived as constitutive of human thinking. However, while culture and things matter, less careful attention is paid to the physical and material properties of the tools and environments through which things and culture are materialised. As Barad (2003) reminds us:

> Language matters. Discourse matters. Culture matters. But there is an important sense in which the only thing that does not seem to matter anymore is matter. (Barad, 2003, p. 801)

Matter indeed matters in professional learning. As one nursing lecturer pointed out, even the most sophisticated high-fidelity mannequin cannot replace fully the real body of a patient when nurses learn manual handling skills.

> One of them [mannequin] we can program to speak. It can do anything – it can vomit, it can have a heart attack and it can say 'ohhhh'.

Nevertheless, mannequins do not look and feel like human beings, because of the very matter from which they are built.

> One of the biggest criticisms is [that] with a real patient, if somebody's sick, they change colour, they go grey and sweaty, and the mannequin of course can't do that because *they're made of rubber*. So that's one of the big criticisms of using simulation. It can't ever really 100 % emulate the real situation.

And as Andy Clark (2011) reminds us,

> Cognition leaks out into *body* and *world*. (Clark, 2011, p. xxviii, emphasis added).

How does mind 'leak' into matter in professional work? We discuss this question next.

16.3 How Matter Matters in Professional Knowledge Work

In professional knowledge work, knowledgeable action and learning, the social, material and embodied come into play and 'matter' in at least four respects: as (a) physical tools, (b) inscriptions and inscriptional tools, (c) embodied skill, and (d) as environment, as knowledge embodied in the world around us. We discuss each of these aspects in the next four sections.

16.3.1 Knowledge Embodied in Physical Tools

Human knowledge embodied in skills is intertwined with the physical and material properties of tools through which this knowledge and skill are developed. The use of different tools requires different skills and allows the development of different understandings of, and relationships to, the objects entangled in this work. In Chap. 12, we used the classical example of a woodworker's skill and knowledge learnt through the use of different kinds of tools. Rabardel and Beguin (2005) note that the use of a hand chisel and the use of a machine develop very different understandings of the properties of wood. Similarly, in nursing, the use of a finger and watch to take a patient's pulse involves different knowledge and skill, and develops a different understanding about the human body and tools, than is the case with an automatic monitor registering a pulse. However, 'complexification' of technology does not mean simplification of skills and knowledge. Learning to embrace new tools for enhancing human powers, or for inscription, visualisation and manipulation of messages, goes along with the education of new skills, new senses and new ways of meaning-making. As Grasseni (2010) puts it,

> . . . there is no fixed algebra of skill and machine by which an increase of technology means a decrease in skill. (Grasseni, 2010, p. 10)

The constitutive role of the material properties of physical modelling devices, and indeed entire experimental setups, in constructing human knowledge and understanding in research laboratories, has been well documented. As Rheinberger (1997) argued, deriving ideas from the material and imposing abstract ideas and concepts on experimental devices and empirical materials are inextricably interconnected in creating new knowledge,

> They [experimental setups] are not simply experimental devices that generate answers; experimental systems are vehicles for materializing questions. They inextricably cogenerate the phenomena or material entities and the concepts they come to embody. Practices and concepts thus 'come packaged together'. (Rheinberger, 1997, p. 28)

This constitutive entanglement between the materiality of symbolic tools (and conceptual artefacts) and knowledge is not universally recognised. For example, as Bereiter (2002) argued, conceptual artefacts, which are often used in creating new knowledge, are commonly inscribed in certain media – paper, video or digital file, for example – but, in Bereiter's view, conceptual artefacts should be distinguished from their representations:

> . . . the representation or concrete embodiment is *not the knowledge*. (Bereiter, 2002, p. 64, emphasis added)

In contrast, Latour (1990) made a distinction between 'mentalist' and 'materialist' notions of inscriptions and, acknowledging the vital role of material practices in knowledge work, argued that powerful explanations could be found in imagining and writing craftsmanship,

> . . . in the way in which groups of people argue with one another using paper, signs, prints and diagrams. (Latour, 1990, p. 21)

Latour noted that the qualities of inscriptions as real physical things are consequential. Others have pointed to the ways that perceptual and other material qualities of symbolic tools are entangled with human thought. For example, Gleick (1993) recounts an insightful exchange between the physicist Richard Feynman and the historian Charles Weiner. In response to Weiner's note that Feynman's materials represent 'a record of [Feynman's] day-to-day work', Feynman reacted,

> I actually did the work on the paper. (Gleick, 1993, p. 409)

To Weiner's, comment 'Well, the work was done in your head, but the record of it is still here', Feynman reacted,

> No, it's not a *record*, not really. It's *working*. You have to work on paper, and this is the paper. Okay? (loc. cit.)

While the Weiner–Feynman exchange concerned the mediational role of inscriptional media in general, others have specifically focussed on the physical and structural qualities of physical representational devices.

Hutchins and Klausen (1996), observing the movement and distribution of information among pilots and devices during a flight simulation, argue that the structure and physical properties of representational tools and media, and the specific organisation of the representations supported by different media, have consequences for the cognitive processes of individual pilots and of the cockpit system,

> Every representational medium has *physical properties* that determine the availability of representations through space and time and constrain the sorts of cognitive processes required to propagate the representational state into and out of that medium. (Hutchins & Klausen, 1996, p. 32 emphasis added)

Summarising research on visual representations, such as diagrams, Nersessian (2005) points to their perceptual cognitive qualities, noting particularly that

> . . . external representations differentially facilitate and constrain reasoning processes. Specifically . . . diagrams can play more than just a supportive role in what is essentially an internal process; these external representations also can play *a direct role in cognitive processing*, without requiring the mediation of an internal representation of the information provided in them. The external representation can change the nature of the processing task. (Nersessian, 2005, p. 28, emphasis added)

She continues by pointing out that there is no clear boundary between internal and external, and the notion of memory and its workings naturally extends outside the human mind,

> . . . to encompass external representations and cues; that is, specific kinds of affordances and constraints in the environment are construed, literally, as memory in cognitive processing. (loc. cit.)

Nersessian develops this argument further by observing that inscriptional matter does not *always* matter. Depending on circumstances, a diagram can be inscribed

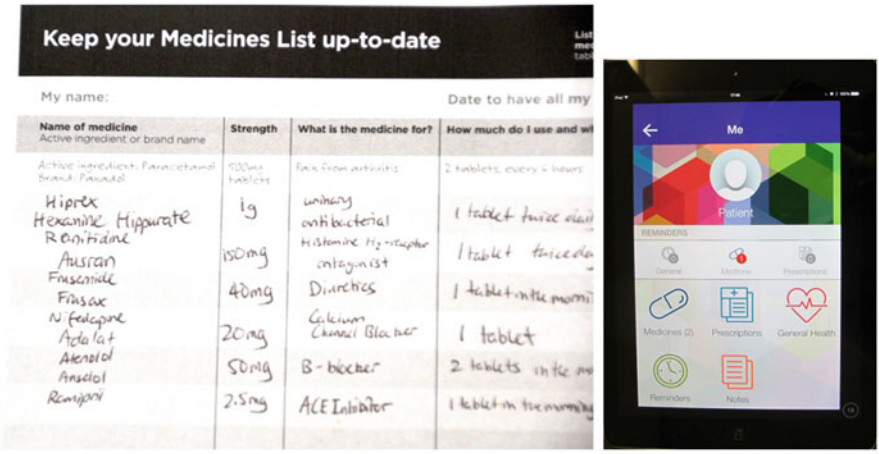

Fig. 16.1 Medicine lists in different material bearers

and discussed with equal success on a piece of paper or a whiteboard. But sometimes – for example, if a diagram is inscribed in computational media or if it needs to be seen by large numbers of people at once – then the material qualities of the inscription can make a huge difference, affecting thought and outcome (see also Coopmans, Vertesi, Lynch, & Woolgar, 2014; Nersessian, 2008).

The skill needed to recognise the 'rightness' ('fitness') of media is important not only for professional vision but also for action. This fitness varies in rich, multimodal and textured ways that are not easily reducible to one denominator.

For example, one of the pharmacy students in our study found himself thinking about the choice of giving a patient a 'Medicines List iPhone App' rather than completing a conventional printed Medicines List to help the patient keep track of medicines taken (Fig. 16.1). The student spent a while figuring out how this digital Medicines List actually works and concluded that 'reminder functions' would be very useful for older people who have difficulties remembering which medicines they should take and when they should take them. But then, the student asked himself a rhetorical question: 'Do older sick people really have iPhones?' – observing that this unlikely to be so. A small misalignment between the material modality of the inscriptional medium ('What can it do?') and its social modality ('Who can afford it and is willing to use it?') changes the epistemic capacities of a tool in radical ways.

16.3.2 Knowledge Embodied in Inscriptional Tools

A lot of attention has been paid to how codification systems (Bowker & Star, 1999), images (Coopmans et al., 2014) and physical tools (Clarke & Fujimura, 1992;

Keller & Keller, 1996; Vaesen, 2012) shape perception and cognition in human development and in professional epistemic work. In contrast, the cognitive consequences of the *structure* and *matter* of various structuring inscriptional devices and structured inscriptions have not received much attention in research on professional work. For many teachers, worksheets and other guiding structures are primarily tools for learning – though choices about them are often made intuitively. ('It just feels right'.) However, professional inscriptions often go unnoticed in their daily epistemic work. Asked about their role, teachers (and other professionals) would often answer: 'It is just a set of boxes' or 'It is just a form'. But what *form* should an effective lesson plan take? Why is it important to have it on an A4 piece of paper? What does a good medication review report look like? What are the epistemic consequences of the structuring devices within which such effective professional inscriptions are constructed? When one stops and reflects on such questions, the answers are far from straightforward.

As we said at the end of the last chapter, in order to be effective, such inscriptions should be inscriptions of competent and effective solutions and also competent and effective inscriptions of professional solutions. In short, what matters is the combination of the 'right' content, 'right' form and 'right' matter (Falconer & Littlejohn, 2009).

But what does this 'right' form and 'right' matter look like and how does it shape knowledgeable action? Consider a lesson plan. Should it be detailed and elaborate? One lecturer explained to us:

> Well, there are – I think there [in a detailed, long plan] are two traps there. If it's too long, students *might feel very constrained* by this and might not allow a natural flow of teaching and questioning from the students on the floor to come back and to devote time to that. So there's the one thing. Or they *might get really anxious* because they might see half way through the lesson they're not going to get there and then they might either leave things out or dismiss things or get really into a state because it means they haven't allowed perhaps down the track enough time to catch up. So that's all a balancing act. (Education Lecturer)

Having just a few points on a piece of paper, as the lecturer explained, is usually a more effective inscription of a plan than having something more complicated:

> And the less bullet points the better, because *you have a little piece of paper on your desk* to make sure that you're on track and at the end of the 45 minutes or the double lesson, you've actually have achieved 'I'm going to do this' because if not, sometimes you might depending on what happens in the classroom. (Education Lecturer)

In this regard, experts, as Clark (2011) puts it, are 'doubly expert'.

> They are expert at the task in hand, but also expert at using well-chosen linguistic prompts and reminders to maintain performance in the face of adversity. <. . .> the linguistic tools enable us to deliberatively and systematically sculpt and modify our own processes of selective attention. (Clark, 2011, p. 48)

Moreover, the symbolic-visual shape of epistemic tools, and epistemic forms in particular, has both cognitive and social consequences in professional knowledge work. For example, a form that prompts students to align identified problems with possible recommendations (Fig. 14.7) or a list that students use to prioritise

problems (Fig. 14.8) has this cognitive purpose – which is achieved via a combination of *linguistic* and *spatial organisation* that 'sculpts attention' (Clark, 2011, p. 48). As Norman (1991) argued, in well-designed artefacts and tools that serve a cognitive function, the form of representation is an important choice:

> The form of representation used by an artifact carries great weight in determining its functionality and utility. *The choice of representation is not arbitrary*: Each particular representation provides a set of constraints and intrinsic and extrinsic properties. Each representation emphasizes some mappings at the expense of others, makes some explicit and visible, whereas others are neglected, and the physical form suggests and reminds the person of the set of possible operations. Appropriate use of intrinsic properties can constrain behavior in desirable or undesirable ways. (Norman, 1991, p. 34)

Furthermore, a lesson plan and a medication review template become effective epistemic forms not only because they sculpt the user's perception but also because – through their shared and recognisable material forms – they sculpt the joint perception and cognition of people working together.

In summary, the cognitive and social are constitutively entangled within material–symbolic professional epistemic devices. For example, an effective form for a medication review should have a socially recognisable *shape*, should guide a pharmacist in prioritising and aligning problems with solutions, should be concise and in any other consequential ways should guide perception. From this perspective, effective epistemic devices are effective material and symbolic embodiments that can be effectively entangled with epistemic work and action.

16.3.3 Knowledge Embodied in Bodily Skills and Senses

Various *embodied experiences* that are seemingly unrelated to the human mind – such as not getting anxious if a lesson does not go according to plan or not getting daunted by an unfamiliar environment – as well as *bodily movements* are also entangled in the very act of knowing. What is this knowledge – embodied within human flesh and feelings?

The human body and embodied knowledge are a focal area in various domains, including feminist, materialist and post-humanist studies, cognitive sciences, philosophy and neurosciences.

Davis (1997), drawing upon contemporary feminist scholarship, describes embodiment by taking seriously into account individual experiences and practices, as 'individuals' actual material bodies or their everyday interactions with their bodies and through their bodies with the world around them' (p. 15) and as 'the relationship between the symbolic and the material, between representations of the body and embodiment as experience or social practice in concrete social, cultural and historical contexts' (loc. cit.).

Similar interests in human embodied experiences appear in materialist and post-humanist theoretical accounts. Here, however, as Mulcahy (2000) concludes, embodiment primarily implies socio-material practice that produces 'knowing locations' (see also Law, 2003). This embodied knowledge may not necessarily

imply unique individual experience, but it implies a *performative* knowledge, and locations imply not only physical spaces but various kinds of embodied phenomena experienced in the world, including human and nonhuman bodies, routines, texts, tools, organisations and economies. A 'knowing location' as Law (2003) notes is not about 'cognitive knowledge' that can be written down as a set of rules or principles, but a kind of tacit knowledge that resides in a person and their relations. This knowledge is in the relations between the person and a whole array of external things,

> ... knowing may be understood as an effect of recognition and consequent possible intervention generated at a particular location by a heterogeneous array of materials. (Law, 2003, p. 11)

Mulcahy (2000) draws a distinction between 'universalistic' knowledge (which is usually explicit) and the (often tacit) 'particularistic' knowledge involved in embodied performance and experienced judgement. Defining competence, she notes,

> ... competence is a complex outcome or, better perhaps, event. Competence development in its 'richest' sense involves a number of processes – discursive and material – which are only partially assimilable. Rather than regarding competence as something individuals or organizations *have*, it might be better to regard it as something that they *do* and provide products which can assist training practitioners and participants to analyse the dynamics of the processes through which competence is achieved. Perhaps we should think more in terms of competence *through* work than competence *for* work. Or, better again, regard it as both product and process and provide strategies for managing the tension between this double reality. (Mulcahy, 2000, pp. 521–522, original emphasis)

She argues that particularistic knowledge, being hard to express, is often marginalised or ignored in competency standards and similar formal accounts of learning. Such accounts have an overriding concern for outcomes and evidence, rather than the processes through which these outcomes were achieved, thus they overlook embodied kinds of knowledge that are central to competent performance.

Agreeing with, and extending, this materialistic account, Beckett (2004) suggests that embodied competence and generic skills can be reconciled by putting the emphasis on 'inferential understanding',

> ... a form of doing ['knowing how' to go about], where there are distinctive reasons articulable in that process of doing (the 'knowing why'). (Beckett, 2004, p. 505)

In a nutshell, according to Beckett's view, inferential understanding emerges from judgements-in-context, by articulating 'what is done (materially)' in public professional language, i.e. expressing 'what is done (discursively)' (op. cit., p. 499). This view of embodied performance implies that understanding is developed by doing and then giving 'epistemological significance' to certain kinds of decisions and experiences. Embodied competencies are passively constructed by doing and then reflecting, rather than actively 'engineering the self' and 'engineering the environment' in order to gain this situational understanding and insight.[3]

[3] In other words, we would say that people create actionable knowledge and learn for action not by acting and then reflecting (a.k.a. representing) but by *enacting*: by bringing forth meanings and the world.

Some neuroscientific, cognitive and philosophical accounts offer other useful views on how bodily senses and environmental supports are intermingled in human cognitive activity (Clark, 2011; Damasio, 2012; Hutchins, 2010). Neuroscientific studies provide increasing evidence that bodily states are inseparable from human consciousness and intelligent behaviour. As Damasio (2012) argues, we all have our bodies in our minds and, at all times, bodies provide a backdrop for human feelings, conscious experiences and interactions with the world:

> Body mapping of the most refined order undergirds *both* the self-process in conscious minds *and* the representations of the world external to the organism. The inner world has opened the way for our ability to *know* not only that very inner world but also the world around us. (Damasio, 2012, p. 114, original emphasis)

Extending this line, Andy Clark (2011) argues that human reasoners lean heavily on bodily senses and environmental supports. Following Kirsh and Maglio (1994), he distinguishes between 'merely pragmatic actions' that involve physical change desirable for its own sake (e.g. giving a box with medications) and 'epistemic actions' that 'alter the world so as to aid and augment cognitive processes' (Clark, 2011, p. 222) – e.g. using a formula to calculate a renal function, checking expiry dates on the medications). These latter cognitive processes (epistemic actions) are not necessarily wholly in the head, but often involve parts of the world. They are rearrangements that may not be seen as a core part of the 'real' action, but are a part of thought or mental action and mental perception. Andy Clark underlines the importance of bodily experience and situated knowledge in this regard,

> With time and practice, enough bodily fluency is achieved to make the wider world itself directly available as a kind of unmediated arena for embodied action. At this point, the extrabodily world becomes poised to present itself to the user not just as a problem space (though it is clearly that) but also as a problem-solving resource. <. . .> At such moments, the body has become "transparent equipment" (Heidegger, 1927/1962): equipment (the classic example is the hammer in the hands of the skilled carpenter) that is not the focus of attention in use. Instead, the user "sees through" the equipment to the task in hand. (Clark, 2011, p. 10)

However, referring to active sensing and the extended mind, he introduces a different kind of experiential and bodily knowledge than is usually implied in the notions of tacit knowledge and in the different kinds of environmental knowledge found in more established situative accounts. He describes 'real cognition' as processes in the head that are 'portable' and offers a broader concept of the 'naked mind' – 'a package of resources and operations we can always bring to bear on a cognitive task, regardless of the local environment' (op. cit., p. 224). Brain and body comprise of a package of basic portable cognitive resources that incorporate bodily actions into cognitive processes. The external coupling between mind and environment is a part of this basic package – the fish's capacity to swim involves the capacity to couple its swimming behaviours to the externally occurring processes and obstacles (swirls, rocks, eddies, etc.); similarly, a coupling of the human body with the external world (and symbols) constitutes human thought.

Epistemic fluency inevitably involves bodily 'knowing' that is grounded in a deep sense of context and self. The embodied performative skill is important. For example, preservice teachers need to get the pitch and timing right in order to be able to deliver a lesson competently and fluently; nurses need to get a sense of the human body in order to perform fluently their various procedures; the psychologist needs to be able to learn to 'hear' reading mistakes while a child reads, in order to carry out a reading assessment; and so on. This kind of embodied knowledge is particularly important in professional learning, but often considered as 'lower-order' knowledge, and it rarely gets sufficient attention in higher education. However, having an instrument that guides perception helps the pharmacist to focus his attention on carefully checking medication expiry dates, storage conditions or inhalation techniques; seeing what kind of medication would be most convenient to take because of social conditions, etc.; and not feeling overwhelmed with details of the unfamiliar environment of the patient's home. Such a distribution of embodied knowledge is particularly critical for its learnability and its grounding in the epistemic tools. This kind of embodied knowledge and knowing underpins knowledgeable action. It is active embodiment rather than passive embodiment, or more precisely, skilled, knowledgeable embodiment.

That said, it is insufficient to focus only on educating the 'human body' alone. More relevant is the triplet of 'body–mind–environment'. The environment of action (things in this environment) is the key for learning this kind of knowledge: medication boxes, assessing the patient's ability to take medications, access/distance to a health service centre, etc. – all of this is in the assemblage within which knowledge is constructed and enacted. We are speaking of more than just 'a context', but rather of real things that enter knowing and knowledge production.

16.3.4 Knowledge Embodied in the World

Empirical encounters with the world provide an essential experiential resource for knowledge and learning. But where do the experiential resources of the environment come from in university settings? This is not easy. Affordances and constraints that are natural in professional worksites and pervasive in professional knowing cannot be relied on to occur naturally in university settings. Thus, the affordances and constraints essential for a skill and knowledge (and task) have to be artificially created. Universities do this in a variety of ways. Here we should be explicit that 'authentic environments with affordances and constraints' and 'affordances and constraints of environments relevant for the task' are not the same. While the two are intertwined, they are not identical. (The distinction is like that between possible affordances and perceived affordances or those affordances of the environment relevant for the skill. Not everything that exists in the environment enters perception and professional vision.) To construct an authentic workplace environment in the university environment is an impossible, and perhaps an irrelevant, task. People come to university *to learn* for work, not *to work*.

But to assemble a learning environment with professional affordances and constraints (or perhaps, reconstructed professional affordances) in order to support the learning of specific kinds of skills or specific kinds of tasks is a more feasible and relevant aim.[4] Yet an 'experiential' context, on which knowledge and skills can be 'hooked', is essential.

How do university teachers do this? The counselling psychology course, which we discussed in Chap. 10, nicely illustrates the range of approaches that teachers take in creating environments for learning embodied kinds of knowledge.

In order to learn how to do behavioural assessments, students went out to schools: that is, to the real environment. The learning environment was created in a workplace setting, rather than the other way around. To carry out the reading assessment, students picked out a child whom they knew. So this was not necessarily a child with any reading difficulties, yet a real child providing the necessary key 'affordances' of a workplace environment for doing this kind of assessment and learning the relevant set of skills.

Before this, for practising literacy assessment, students used a tape recording that could be 'slowed down', 'paused', 'replayed' and so on. While such affordances have some natural qualities, in this case, they are blended deeply with additional learning affordances. Such 'artificial remaking' is not a limitation, but a necessity for learning, sculpting perception and rehearsing.

To learn to carry out other kinds of assessments and tests, counselling students tried them out on each other during tutorials. This approach has limitations, but it also has learning affordances: such as making it possible to experience how it feels to be tested and engagement in joint reflection.

In the teacher education programs we observed, students' past experiences as learners were also used as an experiential resource for them to reflect and think about how they might teach.

In short, different kinds of 'substitutes' – or blends of authentic work situations and learning situations – are dynamic multimodal affordances that have modalities relevant to learning certain kinds of skill and certain kinds of knowledge. They are not real and not authentic in a simple sense, but they are made for learning a real professional skill and vision – a more universal competence that, in any case, has to draw on a small selective set of affordances available in natural workplace contexts.

Of course, sometimes these substitutions can be very crude (remote) and lose key affordances that configure professional perception: they break the ecology of perception. As in the pharmacy case, with a tutor role-playing a patient and a doctor, the voice, physical appearance, discourse, way of seeing the world and other personal characteristics are critical perceived affordances for a pharmacist in this task, yet cannot be acted out with sufficient accuracy. Or in other situations, the

[4] Indeed, there is a very fundamental human capacity, on which the modern mind has historically developed, that is largely ignored in professional education. This is the 'mimetic skill' used in rehearsing and fine-tuning the body and mind in systematic and voluntary ways (Donald, 2001). Billett (2014) is helping rescue the concept.

entire home environment of the patient is substituted by a couple of boxes with medications, or the interview with the patient is replaced by a narrative description of what was said by a patient and what was observed during the home visit.

In short, affordances of the context and experiential resources are important for learning to use professional tools and to do professional tasks. Lack of experience and lack of real environments to get this experience are a challenge for learning, but things are not so 'black and white' when the purpose is to learn, to sculpt perception and to rehearse skill, rather than learn by mere doing. Effective tasks and environments for learning – for sculpting attention, for seeing relationships, for rehearsing – are not necessarily the tasks and environments of authentic workplace settings or the real world.

Overall, different kinds of epistemic games, by their nature, involve different relationships between the mental and experiential aspects of knowledge work. Some epistemic games, such as those involved in lesson planning, are played prior to the action, even by professional teachers. Thus, they build heavily on previous experiences, imagined contexts and projected situations. Other epistemic games, such as in medication assessment, are played mainly in direct interaction – in the unfolding experience – and therefore, many parts of this game, such as information gathering and delivery, need socially and materially real and rich environments and real interactions. In contrast, the environment for what pharmacy teachers called 'information processing' (the processing part of the game) can be recreated in a university setting, as this environment is tightly linked to an information infrastructure that is now quite universal, including handbooks, databases, manuals and so on.

16.4 Learning and Thinking with Social Others

One cannot really talk about the 'social' professions without taking a serious look at the 'social'. Professional thinking and action encounter the social in a variety of ways. Here we concentrate on two main aspects of this encounter: (a) how the human mind and professional meaning-making are *extended by* the social (Sect. 16.4.1) and (b) how professional learning and meaning-making are *enacted with and through* the social world (Sect. 16.4.2). Then we discuss implications for learning (Sect. 16.4.3).

16.4.1 The Socially Extended Mind

If the mind can be extended with the body and the external physical world, then similarly it can be extended with the minds and bodies of other people, through symbolic human actions and social worlds. As Andy Clark (2011) puts it,

one's mind is 'partly constituted by the states of other thinkers' (p. 231). He goes on to say

> . . . if [this] view is taken seriously, certain forms of social activity might be reconceived as less akin to communication and action, and as more akin to thought. (Clark, 2011, p. 232)

From Clark's perspective, there is not a strong distinction between social and material (including symbolic) extensions of the human mind, such as notebooks or to-do lists. As Clark argues,

> What is central [for the socially extended mind] is a high degree of trust, reliance and accessibility. (op. cit., p. 231)

From this perspective, the social is not just a context in which a self-contained mind operates using its own intrinsic powers, but rather it is a sufficiently stable, transparent, tangible extension of the mind. Humans can extend their minds with other humans' minds in ways that are similar to material extensions. For example, why should a doctor bother learning how to sort out complex issues with medications if she could ask a pharmacist to do this? From this perspective, humans and nonhumans are a part of the instrumental assemblage that is weaved into one's cognition. The relation between the 'knower' and the rest of the social world tends to feel asymmetrical: others might be thought of as a part of the epistemic environment for a person's own knowledge work. While knowledge work is seen as social activity, knowing is generally a mono-agent (person-solo) activity – something that happens in an individual, albeit socially extended, mind.

However, if we acknowledge that the *generative mechanisms* of meaning-making (*how* we know) 'leak' into the social world, then we need to go beyond this basic functionalist extension and accept that knowing is not only a monological person-solo activity, characterised by an internal monologue and *intra-action*, but also *interaction* with social 'others'. So we need to reconsider the roles of social interactions in professional knowing and learning.

16.4.2 Dialectical, Dialogical and Trialogical Perspectives

The literature offers three main views on how personal and shared knowledge are constructed through social interactions: the dialectic, dialogical and trialogical views.

Ravenscroft, Wegerif, and Hartley (2007) distinguish between *dialectical* and *dialogical* stances towards thinking and learning. Dialectic and dialogic are two different ways of seeing the role of social others in constructing shared knowledge and personal understanding. Both views agree on the point that knowledge and understanding are primarily products of social interaction, but the views differ in some other important ways.

The *dialectical* perspective is based on a coherence view of knowledge and truth. On this view, knowledge involves an entire system of propositions with its own

structure and rules. Understanding arises in the dialectic interaction between humans and the world. From this perspective, learning is mediated by tools, including words as sign tools, and higher-level mental processes – such as articulated thought, logical memory and selective perception. It is constructed from 'outside' to 'inside'. Tools are learnt through a social process, as one participates in an activity with a more knowledgeable 'other' and, through external interaction, learns and internalises those tools. Development of one's understanding (and similarly expertise) progresses from participatory, heterogeneous thought towards increasingly more rational, systematic, internally mediated thinking and reasoning. On this view, professional learning involves developing expertise in the use of a range of epistemic tools and in how to play a range of epistemic games, be they propositional, problem-solving, professional or involving public discourse. The guiding principle for success is an ability to choose the right tools and use them correctly.

The *dialogical* view, in contrast, opposes the possibility and primacy of a single perspective as a basis of understanding and argues that learning is mediated by the perspectives of others. The main mechanism for understanding and learning involves taking the perspectives of real or generalised others. Learning is not so much about mastering a coherent set of tools, but developing an ability to see things from a new point of view and change one's way of seeing. Dialogue, here, is a source of new perspectives. Expertise, creativity and learning primarily emerge from participation in dialogue and from being open to the emergence of new ideas.

Ravenscroft et al. (2007) argue that dialectical and dialogical views are not in opposition, but that they have different emphases. While the dialectical approach emphasises intrapersonal cognitive and epistemic aspects of knowledge, the dialogical approach emphasises intersubjective and interpersonal aspects.

> The desire to reason to progress towards a rational synthesis does not have to override the need to understand others, and likewise, the desire to understand others does not have to override the often pragmatic need to reach a rational consensus that links to purposeful action in a context. <...> [D]ialogic relations precede and exceed dialectic ones, as they are the necessary medium of reflection and therefore of understanding. On the other hand, the construction of useful cognitive artefacts and tools that embody shared understandings and carry them forward between dialogues occurs through dialectical processes. <...> [D]ialectic without dialogic is blind (as in machine cognition), dialogic relations without dialectic is empty of content. <...> [I]t is through their union that new shared understanding can arise. (Ravenscroft et al., 2007, p. 47)

Paavola and Hakkarainen (2005) extend these two common views of perceiving thinking, knowing and learning by suggesting a *trialogical* perspective. They argue that knowledge advancement and learning to create knowledge involve collaborative processes through which shared *objects* of activity are developed. Such processes do not focus solely on the interaction and dialogue between people but also on the interaction through, and the creation of, shared objects of joint activity and mediating conceptual and material artefacts.

> *Trialogue* means that by using various mediating artifacts (signs, concepts and tools) and mediating processes (such as practices, or the interaction between tacit and explicit

> knowledge) people are developing common objects of activity (such as conceptual artifacts, practices, products, etc.). <. . .> Artifacts are object-like things that are produced by humans, and the models of innovative knowledge communities concentrate on processes where people collaboratively create and develop such conceptual and material artifacts and related practices for a subsequent use. (Paavola & Hakkarainen, 2005, pp. 545–546)

On this perspective, learning and expertise involve a mastery of shared tools, engagement in dialogue with social others and a capacity to develop concrete shared objects that integrate individual situated understandings and produce new conceptual meanings that are objectified in the mediating artefacts.

16.4.3 Implications for Professional Work and Learning

How does this notion of the social enter into the practices of teaching and learning to play professional epistemic games? The distinction between dialectical, dialogical and trialogical views is useful. The *dialectical* approach would foreground individual learning (from more knowledgeable others) of the available professional tools and of rules for engaging in professional epistemic games. The *dialogical* approach, in contrast, would foreground playing these games collaboratively with social others in various epistemic spaces. The *trialogical* approach – focussed on the joint creation of epistemic artefacts – involves developing the skills needed to coordinate one's unique individual capacities with the capacities of others, by using shared tools.

The main difference between dialectical and dialogical forms of knowing is the distinction between single-agent and multi-agent views. In the dialectical case, agency is attributed to the solo professional as a problem-solver who brings established professional ways of knowing to the situation. In the dialogical case, agency is attributed to multiple agents who may bring to the situation *different* knowledge resources and perspectives. New shared meanings emerge from successful relationships between the two.

As we showed in Chap. 14, professional work involves epistemic games that, from the social perspective, involve interactions with different sets of people. We can focus here on three such sets: intra-professional, trans-professional and public (see Table 16.1).

Intra-professional knowledge work primarily involves propositional knowledge and problem-solving epistemic games and meta-professional dialogue for individual (monological) or collaborative (dialogical) work. The way such mono-professional knowledge is constructed and learnt could be monological, dialectical or dialogical. The product of such games will usually be real epistemic professional artefacts, e.g. reflective journal entries, nursing guidelines or lesson plans.

Trans-professional work draws on an ability to participate in professional discourse across professions. This involves mastering the rules of trans-professional discourse games, in shared epistemic spaces, using and creating various

Table 16.1 How the social enters knowledge work: dialectical, dialogical and trialogical perspectives

Nature of knowledge work	Nature of learning and knowing		
	Dialectical	Dialogical	Trialogical
Intra-professional Propositional, problem-solving, meta-professional epistemic games	Learning focussed on individual skills, knowledge, preparing for monological problem-solving (e.g. discussion with more knowledgeable others, apprenticeship)	Learning focussed on one's engagement in intra-professional discourse (e.g. collaborative problem-solving, peer feedback)	Learning focussed on production of professional artefacts (e.g. conceptual games, development of characteristic professional epistemic artefacts)
Trans-professional Trans-professional discourse games	Learning focussed on mastering rules of trans-professional discourse (e.g. simulated case conferences with doctors)	Learning focussed on engaging in trans-professional work, forming relationships, knowing others (e.g. field experiences, interviewing)	Learning focussed on engaging in joint problem-solving and knowledge creation with other professions (e.g. project-based interdisciplinary tasks)
Public Public discourse games	Learning focussed on mastering rules of public discourse epistemic games and skills (e.g. simulated case conferences with patients)	Learning focussed on doing, engaging with contingencies of real situations (e.g. completing a behaviour assessment, teaching a lesson)	Learning focussed on joint creation of shared knowledge (e.g. learning to take the patient's perspective, educating the patient and generating joint solutions)

trans-professional or boundary epistemic artefacts (e.g. referrals from a GP to a specialist, geotechnical reports from a surveyor to an architect).

Public knowledge work primarily involves mastering the rules of social discourse and playing games in the social world. Various social discourse games and constructed artefacts are the main objects that guide this kind of knowledge work (e.g. interviews, medication lists for patients and guidelines for parents).

To some degree, all social professions involve all these kinds of knowledge work. Consequently, they also involve various social embodiments of professional knowledge, such as colleagues, other professionals and clients and also various social extensions of knowledge (i.e. dialectical, dialogical and trialogical). Nevertheless, there is a challenge in creating university learning environments for professional education, such that they provide opportunities to engage and mesh multiple, socially extended ways of knowing. The reason for this is that professional learning environments in higher education are historically constituted for learning mono-professional knowledge.[5] The move from dialectical forms of

[5] The distinction between mono-professional and mono-disciplinary knowledge is important here. For example, pharmacy is a mono-professional field even though it draws on knowledge from multiple disciplines.

learning[6] to dialogical, collaborative forms (such as group projects) changes the *way* students learn, but does not necessarily change the *kinds of knowledge-building* in which they engage or the kinds of knowledge work for which they are preparing (i.e. knowledge still remains mono-professional).

To create authentic learning environments for trans-professional and public knowledge work is a very challenging task in higher education, as situational contingencies are an essential part of such knowing and learning. From this perspective, different dialectical forms, such as role plays and simulations, are forms for dialectical learning of discourse tools and rules, but they cannot replace the dialogical and trialogical forms of knowing in an open epistemic space. It is the situational contingencies that make new trans-professional and public perspectives visible, possible to articulate and mesh together.

16.5 Four Kinds of Mediation: Tools, Social Others, Artefacts and Self

Before finishing we should revisit the relationships among material, embodied and social aspects of knowledgeable action. As we saw in Chap. 15, many epistemic games are 'weaved' games, which are played in dynamic social, embodied interaction between people. The social, the material and the embodied are often too tightly woven into human actions, and with each other, for them to be decoupled. If one thinks of a doctor interviewing a patient or a schoolteacher teaching in a classroom, these games – and the knowledge, knowing and action created through such games – are social, material and embodied at the same time. They are social in a number of respects: action schemes that emerge in such games owe much of their origin to human social interaction; much of the understanding comes from the discourse; the understanding thereby created itself takes the form of discourse.

However, these games are also deeply material and embodied. Firstly, the physical and symbolic *tools* embody understanding in material things. Second, the patient who participates in the interview and the children in the class are embodiments of social knowledge in the deepest sense – discourse embodied in the 'matter' of the human body. Patients, children and other *social others* are objects and subjects at the same time. Knowledge comes from coupling what they say and what they do. Such kinds of epistemic games are genuine multi-agent epistemic games, a kind of socially distributed, embodied, dynamic knowing and knowledge.

Thirdly, epistemic games often evolve around, and produce, *epistemic artefacts*. These are not *usually* the ultimate objects towards which action is directed. Rather,

[6] Be they teacher-led methods, such as apprenticeship or Socratic dialogue, or student-led methods, such as students writing reflective journal entries on which they get teacher feedback.

they are dynamic, materially embodied, mediating things through which knowledge for action is constructed.

Fourth, knowing humans are themselves embodied, socially constructed entities within which consciousness ('self') and action originates. As Damasio (2012) argues, we could consider 'self' from two vantage points:

> One is the vantage point of an observer appreciating a dynamic *object* – the dynamic object constituted by certain workings of minds, certain traits of behavior, and a certain history of life. The other vantage point is that of the self as *knower*, the process that gives a focus to our experiences and eventually lets us reflect on those experiences. (Damasio, 2012, pp. 8–9, original emphasis)

These two perspectives produce the dual sense of conscious 'self': 'self-as-object' capable of interacting with the environment and responding to it and 'self-as-knower' capable of reflecting and constructing a conscious self. But 'self' – whichever perspective we take – is anchored in the *protoself* with its primordial feelings and senses, generated within the living body and the brain.

Traditionally, the mediating role in human sense-making is attributed to tools, including psychological tools (Vygotsky, 1930, 1978) and perspectives of social others (Wegerif, 2011). However, if we see knowledge, not as already given out in the world, but rather as constructed and re-enacted by a knower within a richly sensed environment, then a much richer picture of the mediation emerges.

As pictured in Fig. 16.2, there is a relationship between subject and object: a result of human senses, biological perception and learning. This knowledge is grounded in what Damasio (2012) called *protoself*: human body and the brain capable of sensing its environment. Subconscious perception of the situation,

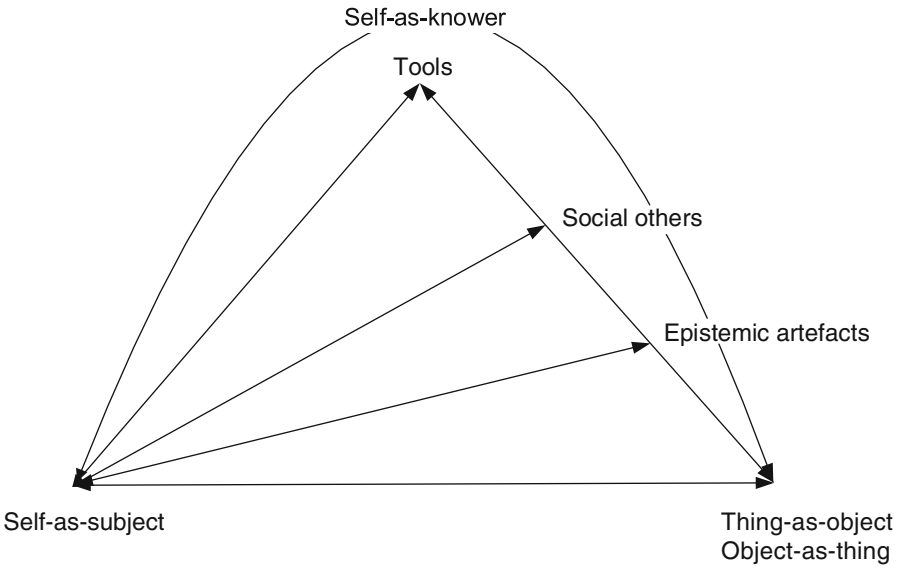

Fig. 16.2 Self and knowledgeable action: four kinds of mediation

spontaneous feelings and other bodily states are often coupled instantly with the encountered object, resulting in a certain immediate reaction. This relationship is often regarded as non-mediated. (But perhaps it would be more accurate to say that there is a relationship between 'self' and 'thing' mediated by the material body and protoself.) Then there are at least four kinds of *mediated* perception and knowing, consequent upon the presence of tools, social others, epistemic artefacts and (not to be overlooked) the self.

There are *tools* (symbolic and material). Tools here could be seen as relatively stable entities with related action schemes. Tools are material or at least are inscribed in some symbolic medium external to the brain, but action schemes are at least partly social: they are learnt in the past, usually through social interactions (see Instrumental genesis in Chap. 12). The relationship here between the subject and the object is mediated by the tool and is dialectical.

There are *social others* in the situation: people who have agency. They have a body (thus, are physical) and use discourse (thus, are social). They are sources of new perspectives, new frames, new ways of looking at and doing things and new feelings. Crudely, they are sources of new ideas and experiences for modifying existing, and creating new, action schemes. As Wegerif (2011) claims, the possibility to see an encountered thing from two perspectives –'the self' and 'the other's' – makes things thinkable and opens up mental space for new creative thoughts. This opens up dialectical space for a dialogue. Social others mediate not only the relationship between the self and the thing but also between the tools and the thing. That is, they have a capacity to change how one uses a tool.

There are *epistemic artefacts* – dynamic physical or symbolic embodiments of the perception and evolving understanding of the object. An epistemic artefact, in this case, is a thing 'meshing' a person's resourcefulness (including her knowledge and embodied skills), tools, perspectives of social others and the object itself. Epistemic artefacts are simultaneously physical things and social constructs that come into being and embody tools and discourse. In the everyday situations of professional work, epistemic artefacts are sometimes coupled with the physical object or action. These artefacts mediate and change not only the relationship between the self and the thing but also between the tools, social others and the thing.

There is also *self-as-knower* with a resourceful mind and bodily skills capable of perceiving the self within the environment and of acting. The self-as-knower builds upon the protoself, with its generated feelings, as well as the self-as-object, with its interpretations of the world, that emerge through the embodied interactions with the thing, tools, social others and epistemic artefacts. The self-as-knower has a capacity to sense and interpret the whole environment, including the encountered thing, epistemic artefacts, perspectives of social others, tools and embodied self by linking all that is experienced as one sufficiently coherent pattern. The emerging pattern gives a standpoint and generates a sense of knowing what it makes sense to do next, within the encountered situation. In short, people understand the world by interacting with the world and interpreting their experiences through their own standpoint: the perspective of the mind relative to the rest of the world, including their body and social others. Such experience is grounded in a variety of sources

(sight, sound, spatial balance, feeling, conscious thought, etc.), but always originates within the head and body of a singular organism (Damasio, 2012).

Our view partly contrasts with, but also extends, traditional sociocultural (Vygotsky, 1930, 1978) and dialogical (Wegerif, 2011) notions of mediation. It does this in six ways.

First, our approach is different from the traditional dialogical approaches that see human discourse as the main mediator of learning. For example, Wegerif (2011) argues that mediation by cultural tools and dialogic relationships with others are not equal and/or mutual: 'dialogic relations *precede* and *exceed* tool use and are not reducible to tool use' (p. 207). From this perspective, dialogue and knowledge come first, and skilful engagement with tools and actions follows. This view obscures the fact that many important aspects of human thinking, skilfulness and learning are as much biological as they are cultural and linguistic (Ingold, 2000; Tomasello, 2014).

Second, knowledgeable action is mediated by *epistemic artefacts*. These 'epistemic artefacts' can be immaterial, but they are usually inscribed in material or symbolic (including digital) media. They are model-like dynamic artefacts through which object and thing come together. Such artefacts embody intelligent perception of the situation constructed through a conscious mind and link perception with knowledgeable action. Epistemic artefacts are essential mediators of knowledge construction and action. They are different from the object/thing, different from the (stable) tools and different from the ephemeral dialogic relations. They *stand for* objects, rather than *are* objects; they are dynamic and they persist through space and time.

Third, tools, social others and objects/things have *not only cognitive but also material*, *social and other modalities*. What epistemic capacities they have, and what role they play in mediating knowledgeable action, is inseparable from what they are, what kind of feelings they generate, what kinds of action they permit in the physical world and what kinds of discourse they enable. For example, as Wegerif (2011) observes, emotions, smiles and other facial expressions are inseparable parts of a person and of a relationship with that person within a learning dialogue, and the quality of these relationships determines whether or not the perspective of the 'other' is taken up. This can be extended to other modalities and other elements of the environment mediating knowing – tools, etc.

Fourth, there is a *distinction between the isolated object and the thing encountered within the environment and specific situation*. The general context in which the object sits – and where the action takes place – is important. (It is one thing to do the medication review in the patient's home, quite another to do it in the pharmacy.) Further, the specific situation, within a textured, perceptually rich environment, cannot be reduced to an abstract, formally perceived context. For example, it is one thing to do a medication review in a wealthy, comfortable, quiet, well-maintained home, quite another to do it in a busy, run-down care home. Formally, the contexts may be similar but the situations for a practitioner are very different. And the decisions may end up being very different.

Fifth, the *subject is not an undifferentiated entity*, but has a body and a mind tightly coupled together within a singular organism (with skills, mental resources and other capacities for perceiving, knowing, acting and reflecting). Skills, mental resources and other capacities are the property of the subject: of their 'self'. They are a part of a transferable toolbox for knowledgeable action. The self, of course, cannot be reduced to a stable entity. Rather, as Damasio (2012) points out, the self is not a *thing*, but a *process* which presents when we are conscious. However, a human's embodied brain has a remarkable capacity to learn composite information and reproduce it later with considerable fidelity and in a variety of ways and combinations.

Sixth, the feeling of knowing generated within the self is not reducible to a non-mediated experience and not reducible to an experience mediated by tools, social others and created epistemic artefacts. It is experience mediated by the self as knowing, embodied agent having a standpoint towards the encountered situation *as a whole* and coming to see how individual aspects – tools, social others, self, etc. – fit into a meaningful pattern that informs action. *Seeing the acting self as an actor, mediator and coordinator of its own knowing, within the environment*, changes the way the self sees not only the object but also its relationships with tools, social others, epistemic artefacts and the overall environment. This view of embodied self-as-knower allows flexible movement between seeing things as objects and objects as things.

16.6 Concluding Points: Learning in 'Thin' and 'Thick' Social and Material Environments

The way we have presented epistemic games and epistemic forms, here and in Chaps. 14 and 15, is of course rather idealised and somewhat 'sterile'. Epistemic practice, as with any other practice, is always more messy, fluid and contingent than the action scheme presupposed by any epistemic tool.

For example, would it be practically possible and meaningful, during the medication review, to separate the interviewing of a patient – finding out about her medications and checking her medication administration techniques – from counselling her about how to take medications? Such a separation is usually neither possible nor desirable. However, the weaving of the game that is designed to collect the initial information (i.e. the interview) with the game that is designed to deliver the outcome (i.e. counselling) is not what the medication review procedure prescribes.

However, epistemic tools (frames, forms, strategies, etc.) and their preassembled and inscribed counterparts (plans, procedures, templates, coding schemes, etc.) are not hard-wired structures in the mind or human skills that should be replicated on each occasion, but tools with a spectrum of flexible usage schemes that have a capacity to bring forth multiple meanings and actions. Epistemic and material tools

are assembled into instrumental ensembles for a task; usage and action schemes are blended and meshed together into the instrumental act (in knowledgeable action).

We should remind ourselves that various role plays, and other pseudo-authentic learning tasks within simulated environments, are not real professional epistemic games. Rather they are games for learning professional epistemic games – which, through certain idealised qualities, help students to educate their senses and develop professional vision. Yet, real material and social contexts are important. The difference here is between 'thin' and 'thick' versions of experience. The 'thin' version gives focus and form to thought and action. As Håkanson (2007) notes, expertise is not just about what to notice but also what to ignore. The 'thick' experiential version gives embodied experience, within which the 'thin' versions gain full meaning.

Vygotsky (1930) compared the development of a child with the education of a child, saying that the natural development of the child happens anyway, but education has a special function and tries to restructure those natural processes through bringing in the psychological tools:

> . . . natural mental processes are not eliminated. They join the instrumental act, but they turn out to be functionally dependent in their structure on the instrument being used. (Vygotsky, 1930, para 22)

This captures one of the main reasons for bringing epistemic tools and games into professional learning. Natural learning would happen in a situated professional context anyway, but the purpose of higher education is 'education' not just 'plain' natural professional development.

While some substitution and simplification of the context can be done for good pedagogical reasons, this is not always the case, particularly when we talk about the social – collaborative learning and collaborative work. The *social* is an important part of knowledge work in professions, and the social is not eliminated from higher education. However, there are different shapes to the social, including intra-professional, trans-professional and public interactions and joint work. Each of these comes with different sets of epistemic games, epistemic tools and socio-material contexts. Students often collaborate and engage in dialogical activities of learning and knowledge production. (At least, getting students to share the artefacts they produce – such as lesson plans and various guidelines and resources – for their future professional work is often perceived as useful and authentic in professional learning.) We do not deny that this may be good, but this kind of collaboration often invokes two associated paradoxes.

Firstly, collaboration among students is usually an intra-professional dialogical form of knowledge construction, such as collaborative problem-solving or peer feedback. In contrast, large parts of real practice in these professions are often (and inevitably) quite lonely, requiring sharp personal professional vision and good mastery of professional tools. Intra-professional collaboration may involve some selected parts of such work (e.g. lesson planning, solving complex problems), but it is not necessarily the core part of everyday professional workplace activities (e.g. dispensing a medication, classroom teaching). Furthermore, such intra-

professional collaboration tends not to pose many epistemic challenges among colleagues who share a similar professional instrumental infrastructure. (The main challenge reported in the literature, and anecdotally, is that they do not collaborate and do not share their knowledge products.)

Secondly, *trans*-professional and public forms of collaboration tend to be an important part of professional work in organisations – particularly during organisational change (Miettinen & Virkkunen, 2005) and in the joint solution of complex practical challenges (Edwards, 2010; Hall, Stevens, & Torralba, 2002) – where professionals with different areas of expertise work together or interact with their clients. Intra-professional collaboration and dialectical forms of learning may help to develop some epistemic tools for these kinds of tasks, but they are unlikely to be good substitutes for dialogical or trialogical trans-professional and public forms of work. Developing relational expertise, seeing things from a different perspective and meshing other perspectives with one's own involve more than just mastering the rules of discourse games but also, as we wrote earlier (Chap. 15), juxtaposing tools, agendas, perspectives and practices and assembling an environment for joint epistemic work (Goodwin, 2005). It turns out to be challenging to create learning tasks and environments for learning such expertise (which extends beyond dialogical and trialogical ways of knowing, to the entire environment).

However, if we accept that learning is a 'second-order' phenomenon and learning these 'second-order' capacities is the main aim of higher education, then the opportunities to develop habits of mind associated with playing various epistemic games, particularly those that are central to innovation, are a valuable focus. What is more, if higher education is serious about dialogical and trialogical forms of knowing, that cross the boundaries of intra-professional work, then its focus should be on 'third-order' games (Argyris & Schön, 1996; Turnbull, 2000) – learning about the epistemic games and tools themselves, learning to construct these games and tools – games that are productive in organisational learning and change.

To put it concisely, much of the attention in professional learning is allocated to learning to use epistemic tools. However, it is important to remind ourselves that understanding professional tools, and the ability to choose the right tools and tweak those tools to meet the needs of the situation, is also important. It is this understanding of the deep properties and capacities of the epistemic tools – and how they fit the requirements of a particular situation – that might help professionals to advance from being tool users to tool builders. This could also foster both general ways of thinking and also thinking contextually.

Clark (2011) notes that 'active externalism' or 'active environmental engineering' is actually 'self-engineering'. Or as Wartofsky (1979) has it:

> . . . our own perceptual and cognitive understanding of the world is in large part shaped and changed by the representational artifacts we ourselves create. *We are*, *in effect*, *the products of our own activity*, in this way; we transform our own perceptual and cognitive modes, our ways of seeing and of understanding, by means of the representations we make. (Wartofsky, 1979, p. xxiii)

In professional education it is not enough to learn to *use* epistemic tools and artefacts. Knowledgeable action also depends on an ability to construct them. We make our artefacts, and then our artefacts make us.

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