

# 1 Introduction to the anthology

*Theresa Schilhab and Camilla Groth*

## **Learning is embodied**

Imagine some of the learning stages you have passed to reach the developmental level where you are today. From your time as an infant in the cradle, reaching for the moving colours hanging from the mobile above your head, to the dinner situation where your hands struggled with finding the right mix of relaxation and tension handling cutlery while your family offered guidance and support, to the endless hours in the classroom, struggling with reading and writing among classmates to cope with the sound and vision of the alphabet.

However diverse, these learning activities entailed that you were in a particular location framed by a specific cultural and social intent, affording and allowing certain behaviours and specific physical actions involving concrete materials in the form of items and artefacts. In all stages, the common denominator was that learning occurred with and because of you inhabiting your body—and that this body was interacting and exchanging with concrete environments and objects which co-constituted the learning. The reaching for distant colours, the challenge of the knife and fork, and the mastering of forming meaningful words from sentences in a book occurred because you were there, situated, interacting with mobiles, cutlery, and sentences in books, investing your mind and body in both informal and formal tasks making sense socially. Even “seeing” is something you have learned since even if you had visual experiences as a baby, you did not know the meaning of what you saw until you experienced approaching objects or understood how perspectives change as you move through a room (Noë, 2006). Only through repeated interactions with, and embeddedness in particular environments, did you become familiar with, the world as you know it today (Bahrck & Lickliter, 2002). This characterisation of learning and knowledge as experiential elements of lived life not only pertains to the early phases of an individual’s life but remains constitutive of learning and knowledge acquisition throughout life. Consequently, embodied aspects of learning are also pivotal to learning and teaching in school—the central topic of this anthology.

### The science of embodied cognition

In contemporary cognitive science, the emphasis on embodied aspects of learning is on the increase. Within the last three decades, a new scientific field has emerged, termed “embodied cognition” (Varela et al., 1991). The name serves as an umbrella term for research revolving around cognitive topics like learning, thinking, understanding, knowledge, experience, and cognition from the perspective of the body. Consequently, the concept of “cognition” reaches far beyond what goes on in the head and applies to the much wider conception of what could be referred to as meaning-making. The field is highly multidisciplinary and builds on, for example, anthropology, psychology, AI research, neuroscience, the brain sciences, linguistics, philosophy, and sociology (Barsalou, 2010). This “new” perspective is not just another perspective in cognitive science but a new understanding of how the human being is learning—this paradigm shift in cognitive sciences fundamentally changes the understanding of how learning happens. But what are the 4Es, and how does this perspective differ from other ways of thinking about learning, such as the cognitivist perspective that has formed the educational theory up until very recently? Embodied cognition views learning and knowledge as relational phenomena in a living body resonating with its social and physical environment, illustrated by the diverse, imagined learning situations in the opening paragraph of this chapter. Consequently, the essence of embodied cognition has been popularised under the name “the 4Es”: the mind is embodied, enacted, embedded, and extended (Menary, 2010; Newen et al., 2018; Wilson, 2002).

***Embodied:*** Cognition is embodied in that it happens in the service of the body (Maturana & Varela, 1987). From an evolutionary perspective, cognition arose to preserve the body through and through. Thus, cognition is not to be viewed as the mental outcome of neural processing and cannot be isolated from the body, which plays a constitutive role in learning (Deacon, 2011). Consequently, educational practices need to be grounded in a thorough understanding of the bodily nature of cognition (Kiefer & Trumpp, 2012). Through social and material engagement, learners gain experiential knowledge and skills that are internalised and later automatised and become second nature, such as walking or seeing.

***Embedded:*** Cognition is always embedded and situated in a context that is consequently also affecting how something is learned. This may be a specific physical environment and/or a social context—for example, learning in nature will be different from learning inside a classroom. The community of other learners, teachers, and the general setting and traditions for learning also affect the situation of learning (Brown et al., 1989).

***Enactive:*** Cognition emerges from or is constituted by sensorimotor activity (Noë, 2006).

Engagement with materials and technologies affects the nature of what is perceived, learned, and understood (Malafouris, 2013). This view is also closely related to a concept called the action-perception loop, which explains

the process of learning from previous experiences in an ecological sense. Through repetitive interactions with our social and material world, we learn to make more realistic expectations and better align our own behaviour and actions in future encounters with similar situations (Clark, 2013). Another strand of embodied cognition theories explains this through the concept of “affordances”. These are opportunities for actions that a person might utilise in their environment and that are usually—but not exclusively—presented as visual cues. Gibson’s (1979) ecological psychology, which lies behind the theory of affordances, has been important for the development of embodied perspectives on cognition, as it is based on the organism’s active engagement with its environment. Thus, perception is not reduced to mere processing of incoming information but is always already anticipating the information and what happens next at the level of the body (Barsalou, 2015; Rowlands, 2010).

*Extended:* Sometimes thinking about something in one’s head is not enough, and to help ourselves in a task, we may “off-load” cognitive load by using external aids. Cognition may be extended through technologies and tools such as writing or note-taking to remember something or the use of fingers when counting a complicated mathematical problem (Abrahamson & Lindgren, 2014). Digital technologies afford considerable opportunities for extending cognition beyond the body (Chemero, 2013; Clark & Chalmers, 1998) but also fundamentally affect the quality and form of learning—for example, reading from a book may be quite different from reading on a screen.

The numerical claim lingering to the term “4E” is not to be taken literally, though. The paradigm is currently only at the brink of an established line of thought—a stage which the philosophers of science would label as pre-paradigmatic and thus characterised by many conflicting views (Kuhn, 1962). Hence, embodied cognition proponents openly discuss to what extent the 4E-label fits with and encompasses the entire field or whether more aspects should equally become enumerated. Some researchers argue for replacing extended with ecological, whereas others propose to add Es like emotion (affection) to the bunch.

However, inherent to the conjecture is that the 4Es are preconditioning all learning with no exceptions. Irrespective of whether the learning in question is basic (such as how to balance a cup, reach for mobiles, or learn to walk) or sophisticated (such as how to read or construct a persuasive argument), the 4Es form the backdrop of the learning in question.

It is worth noting, however, that the 4Es—including putative future Es like ecology, emotion, and probably more—are co-involved and contribute to any learning activity, and cannot be viewed as occurrences in isolation. Also, extended mind learning does not exclusively pertain to mere interaction with external objects. Quite the opposite: extended learning, like using fingers when learning to count, becomes internalised mental processes that reduce introductory overt interactions to distant reminders of the material engagement of the learning.

The consequence is that even operations that would be thought of as “mental” are embodied through and through. Not merely as a result of taking place in a mind in a body which is embedded and responding to both physical and social affordances but as a result of the content of the mental operation bearing the mark of embodiment. For instance, when we think about a future birthday, our thoughts take their form from already experienced birthdays (Schacter et al., 2017). Abstract and rational thoughts, planning and hypothesis creation, and fantasies and imagined futures all rest on embodied, directly experienced encounters with a highly material and sensory world.

This suggestion is quite radical when considering it to its full potential. Fundamentally, the body and its involvement with the world determines learning—also in those instances where apparent connections with the body seem absent, such as learning in virtual games or when controlling thoughts apparently purely linguistically, as exemplified by reading.

Hence, when pupils read about universes, they have never experienced first-hand—say, distant destinations or even places out of space—they must rely on their knowledge of the worlds they have already received (Klomberg et al., 2022).

Embodied cognition means, in short, that the body gains a fundamental role in both cognising and learning, something that mainstream learning theories have neglected to a large degree (Kiefer & Trumpp, 2012; Wilson, 2002). However, even before the 4Es were developed, a few learning theorists have intuitively acknowledged the situated nature of learning (Brown et al., 1989), and the experiential aspects and learning through doing (Dewey, 1938). Socio-material learning theories have also, since Vygotsky (1978), acknowledged that learning is distributed into the social environment of the learner (see also Hutchins, 1995); the 4Es confirm much of these early learning theories.

### **Embodied cognition as a learning theory**

As a learning theory, embodied cognition emphasises the impact of the present and the perspective of the body. There cannot exist a view from nowhere. All learning is through and through embodied, perceptual, biased, and sensorially rich, involving and evolving the learner and the world to an extent that transgresses traditionally conjectured boundaries. When we learn in the now—be it how to cook a bowl of rice, how to sew a pair of trousers, how to compute the division of numbers, or how to interpret the Shakespeare drama of *King Lear*—we are situated bodies using present and previous experiences to cope with the next steps.

However, emphasis on the embodiment perspective does not accentuate the now in the sense one might suspect: that the historical and the cultural aspects of human life are downplayed. According to an article by the emotional psychologist Louise F. Barrett (2009), each moment of our “mental now” draws on three different sources—namely, sensations of our

surroundings, sensations of our interior, and our memory. Consequently, in the embodied cognition perspective, the extended and embedded mind is also about how the sociocultural works by allowing, affording, and subsequently cultivating particular behaviours and endeavours, thus creating and conditioning the paths we have trod and will tread in future.

However, the educational system—e.g., teachers, schoolmasters, and school politicians—is not sufficiently informed about the potentialities and implications of this insight at the curricular level. This book seeks to amend this.

### **Rationale for the anthology**

When addressing the operationalisation of 4E into educational contexts, one way to begin is to explore the implications of the 4E approach for learning in school. Which consequences for teaching should we derive from reconsidering the role of the enactive body embedded in the social and physical environment interacting with tools and artefacts? Acknowledging that the embodied cognition approach is still an emerging framework typically motivated by proof of concept, few scholars have crossed the bridge between embodied cognition and teaching to search for take-home messages relevant to teachers and educational practitioners (Macrine & Fugate, 2022).

Therefore, this anthology aims to establish this new field in the wake of 4E cognition—EmLearning—that integrates embodied cognition perspectives with education using the 4E approach as a guiding principle. The objective is to explore the implications of the approach—i.e., that learning is based on experiences, is highly perceptual, embodied, situated, and interactional in the sense of involving interactions with materials and the physical and social surroundings.

The current compilation takes this challenge seriously. From the perspective of traditional school disciplines—reading, second language learning, technological literacy, science learning, and learning through making—the reader learns about the potentialities and challenges of pursuing teaching and learning in school from the embodied cognition stance.

A few notes relating to the content of the anthology are worth considering. First, teaching how to read and write receives relatively more attention, as these skills precondition most other school subjects. Hence, the first section of chapters provides a general approach to embodied cognition in language acquisition, whereas the following sections contain chapters directed at reading and writing, nature, science and technology, and the aesthetic and practical disciplines.

Second, due to the broad range of disciplines among contributing authors, different interpretations of the central terms exist. While some authors build on a phenomenological heritage when discussing embodiment perspectives, others refer to anthropological associations or are neurobiologically inspired. These are separate philosophical and scientific positions with quite distinct implications. Therefore, most authors explicitly address which kind of

embodied cognition position their chapter endorses and most of them also write explicitly how their theme connects to the 4Es.

Given the uncertainty within embodied cognition about a finite set of Es, in this anthology, we acknowledge that more embodied aspects are likely to be specified in the near future by introducing the notion 4E(+). With this move, we allow for additional Es to contribute to charting the landscape and acknowledge that reality never conforms to artificial categories. It always bulges out of the form so insistently cast upon it by the analytic propensities of the human mind to simplify and control. This more inclusive approach seems feasible to adopt when establishing EmLearning as a field in its own right, focusing on challenges and prospects from the educational and teacher points of view.

It is our ambition to inspire you, as a teacher, to adopt an embodied perspective in your teaching practices. With this compilation of chapters, we invite you to explore where and how to find embodied aspects of teaching. We also hope to support you in finding new trajectories that accommodate embodied cognition learning in your pupils by providing case examples and reframing the learning in terms of 4E. Our objectives are to stimulate and inspire a playful and accommodating way of teaching that improves learning opportunities for learners—especially those who have been challenged by traditional teaching strategies—and to enrich the teaching profession with a more humane and adaptive mindset that delivers more rewarding solutions to tasks.

### **Anthology structure**

We set the scene of the anthology with Lydia Kokkola's chapter 2 "Languages are grounded in the body", a comprehensive introduction to a range of fundamental associations of language with the body. Kokkola presents updated knowledge on the phylogenetic evidence of the development of language capacities and touches upon studies addressing conceptual metaphors. Kokkola also explains how bodily interactions in a social and cultural environment underlie meaning-making in language activities and unfold how, for example, second language teachers can benefit.

The chapter 3 "Exploring reading aloud events through embodied learning: impacts on early literacy" by Theresa Schilhab, Gitte Balling, and Gertrud Lynge Esbensen, operationalises several of the associations between language and embodiment discussed in the opening chapter. The authors conjecture that the benefits of reading aloud for early literacy in preschoolers can be explained using the 4E(+)s as backbone structure. The unfolding also leads to a model charting reading aloud processes to be adopted by practitioners.

Pauline von Bonsdorff and Aila Marjomäki present a comparable use of 4E principles in primary school in their chapter 4 "Inclusive language teaching". Through examples from Finnish primary schools, this chapter discusses how the 4E principles can be implemented in inclusive language teaching. Bonsdorff and Marjomäki report from two reading courses that show structure with plenty of room for children's individual and self-organised group work while the

teachers' enable the learners' literary analyses and storytelling. The authors unfold how the courses, among other things, also supported positive cascades of learning and personal growth in the pupils.

The chapter 5 by Sarah Bro Trasmundi and Anne Mangen, "Substrates, displays, technologies, and texts: embodied, experiential reading", continues the unfolding of relations between language and embodied cognition perspectives, now zooming in on reading activities in particular. Contemporary research of new digital reading platforms has led to reconceptualisations of reading using embodied cognition perspectives. This seems particularly promising as it renews the status of material affordances of the media or artefacts in reading. It also redefines reading as an embodied, multisensory engagement with a text.

In the chapter 6 "Embodied learning with and through different writing methods" by Satu-Maarit Korte and Minna Körkkö, the impact of changed writing affordances is empirically explored. The chapter refers to studies that examine differences in memorising written texts amongst children, adolescents, and adults when handwriting or typing on a laptop, tablet computer, or smartphone. The chapter reflects on the results to formulate practical instructional recommendations for teachers.

Kristiane Hauer takes up the thread of embodied reading to discuss how to best accommodate long-form silent reading in the chapter 7 "Long-form silent reading in the contemporary classroom". The chapter presents empirical cases from primary and secondary schools in Denmark to address the challenges pupils face when engaging in long-form silent reading. The chapter summarises the findings by formulating practices that promote pupils' experiences of success.

Juan Toro and Sarah Bro Trasmundi's chapter 8 "Education in the cognitivist and embodied paradigms. Why won't my students read?" is similarly directed at the challenges confronting reading pupils. In this chapter, the teacher's furnishing of the reading situation is analysed. Toro and Trasmundi conjecture that inaccurate ideas pertaining to the reading process, inspired by cognitivist conceptions, have led to counter-productive reading didactics, leaving demotivated pupils in their wake. They turn to the embodied cognition perspective to build more ecologically valid and sustainable reading didactics.

In the chapter 9 "Thinking through hands in education", Camilla Groth and Marte S. Gulliksen offer a coherent theorisation about how thinking is a process that rests on a sensory connection with the world. Special attention is paid to hands and learning through making and the "sense-making" that takes place in material engagement. The chapter presents examples from the craft practices and expands on how the processes offered by material engagement help students gain resilience, patience, and problem-solving skills that are also relevant to other school disciplines.

Lovise Søyland picks up on a number of theoretical points made by Groth and Gulliksen in her chapter 10 “why whole-body drawing still matters in our digital age”. Through autobiographical explorations, Søyland reflects on how a person’s thinking is mediated through material interaction and specifically explores how drawing may be seen as a way of thinking. In her whole-body drawing experiences over a few days in the freezing temperatures of Norway, we become first-row spectators to the merging of the body with charcoal, paper, and thought. Søyland concludes by offering implications for education.

In the chapter 11 “Apprenticeship as a model for teaching and learning in formal education,” Camilla Groth argues for the benefits of contextualisation of the practices learned in the formal classroom setting. Groth highlights the situated qualities of apprenticeship and discusses these in light of embodied cognition theory. To unfold their implications for teaching, Groth uses a case in clay throwing based on her expertise and her online teaching of students during the COVID-19 pandemic. The chapter embraces both the embodiment inherent to apprenticeship and the potential of new technologies to import some of the situatedness to the classroom through live video connections.

The chapter 12 “Conceptualising technology-enhanced embodied pedagogy” by Satu-Maarit Korte and Minna Körkkö reflects on the potential of technological solutions in primary school in light of embodied cognition aspects. Based on two significant cases, the chapter unfolds and explains how technological solutions can motivate and inspire by, for instance, stimulating agency and pupils’ ownership of their learning. The authors summarise their reflections in a model which operationalises the potency of technology when used ingeniously.

Gertrud Lynge Esbensen, Theresa Schilhab, and Gitte Balling follow up on the previous chapter to take the association between embodied cognition and smart technology use to the outdoors in “smart technology in nature-based learning—embodied and situated processes”. The chapter 13 explores nature-based teaching through smart technology use, from the perspective of embodied and situated cognition as a means to simultaneously stimulate nature-connectedness and technological literacy. The authors also discuss which challenges to consider when using smart technology to promote experiences of nature

In the chapter “How nature-like artworks induce perceptual processes benefiting education in general and science education in particular” by Theresa Schilhab, the focus is on perceptual processes as important precursors for learning in general and for science learning in particular. Based on the author’s reflections on an exhibition and art teaching practices at an arts centre, the chapter discusses to what extent experiencing nature-based artworks stimulates and cultivates perceptual processes and how these may depart from perceptual processes that occur in nature



Alexander Refsum Jensenius' chapter 15 "Embodied music learning" presents the term "musicking" using the embodied cognition framework. The chapter outlines different ways we may relate to musical activities, from a theoretical understanding of music, to actively listening, through to actual music-making. Further, Jensenius addresses how music education in school may become more embodied when adopting more interactive and flexible attitudes to musicking, and perhaps also using contemporary music technologies. He corroborates his assertions by sharing how he developed his own embodied didactics with his students.

Gunn Helene Engelsrud focuses on the integrity of the individual in her chapter 16 "Teaching and learning in physical education teacher education" from the perspective of "bodily resonances" and "letting be". Engelsrud addresses the subjective space between the teacher and the pupil as something the teacher can inhabit when opening themselves to the first-person experience of the pupil. The chapter presents the idea that education and the learner's personal development and formation can benefit from working with emotional and embodied tacit processes at the level of the individual pupil and thus challenges the "one-size-fits-all" kind of classroom teaching.

The chapter 17 "Embodied learning in interaction: the case of aikido" by Susanne Ravn discusses specific instances of resonating with the other using the case of practising the martial arts form aikido. Ravn explores several of the processes presented in the former chapter in an actual intersubjective encounter between actors. Through her own experiences of aikido, Ravn's case unfolds how practitioners develop their skills and abilities to participate not only in relation to, but through, the movement of the other.

In chapter 18, Camilla Groth and Theresa Schilhab sum up the take home messages of the preceding chapters to frame the contours of the emerging field of EmLearning. The chapter concludes with a check list with the dual aim of creating an overview of the topic and nudging the readers to embody Emlearning in their own practices.

## References

- Abrahamson, D., & Lindgren, R. (2014). Embodiment and embodied design. In R. K. Sawyer (Ed.), *The Cambridge handbook of the learning sciences* (2nd ed.) (pp. 358–76). Cambridge University Press.
- Bahrlick, L. E., & Lickliter, R. (2002). Intersensory redundancy guides early perceptual and cognitive development. *Advances in Child Development and Behavior*, 30, 153–89.
- Barrett, L. F. (2009). The future of psychology: Connecting mind to brain. *Perspectives on psychological science*, 4(4), 326–39.
- Barsalou, L. W. (2010). Grounded cognition: Past, present, and future. *Topics in Cognitive Science*, 2(4), 716–24.
- Barsalou, L. W. (2015). Situated conceptualization: Theory and applications. In Y. Coello & M. H. Fischer (Eds.), *Foundations of embodied cognition: Perceptual and emotional embodiment* (pp. 11–37). Routledge/Taylor & Francis Group.

- Brown, J. S., Collins, A., & Duguid, P. (1989). Situated cognition and the culture of learning. *Educational Researcher*, 18(1), 32–42.
- Chemero, A. (2013). Radical embodied cognitive science. *Review of General Psychology*, 17(2), 145–50.
- Clark, A. (2013). Whatever next? Predictive brains, situated agents, and the future of cognitive science. *Behavioral and Brain Sciences*, 36(3), 181–204.
- Clark, A., & Chalmers, D. (1998). The extended mind. *Analysis*, 58(1), 7–19.
- Deacon, T. W. (2011). *Incomplete nature: How mind emerged from matter*. WW Norton & Company.
- Dewey, J. (1938). *Experience and education*. Macmillan.
- Gibson, J. J. (1979). *The ecological approach to visual perception*. Houghton Mifflin.
- Hutchins, E. (1995). *Cognition in the wild*. MIT Press.
- Kiefer, M., & Trumpp, M. N. (2012). Embodiment theory and education: The foundations of cognition in perception and action. *Trends in Neuroscience and Education*, 1, 15–20.
- Klomberg, B., Schilhab, T., & Burke, M. (2022). *Picturing fiction through embodied cognition: Drawn representations and viewpoint in literary texts*. Routledge.
- Kuhn, T. S. (1962). *The structure of scientific revolutions*. University of Chicago Press.
- Macrine, S. L., & Fugate, J. M. (Eds.). (2022). *Movement matters: How embodied cognition informs teaching and learning*. MIT Press.
- Malafouris, L. (2013). *How things shape the mind*. MIT Press.
- Maturana, H. R., & Varela, F. J. (1987). *The tree of knowledge: The biological roots of human understanding*. New Science Library/Shambhala Publications.
- Menary, R. (2010). Introduction to the special issue on 4E cognition. *Phenomenology and the Cognitive Sciences*, 9, 459–63.
- Newen, A., De Bruin, L., & Gallagher, S. (2018). *The Oxford handbook of 4E cognition*. Oxford University Press.
- Noë, A. (2006). *Action in perception*. MIT Press.
- Rowlands, M. J. (2010). *The new science of the mind: From extended mind to embodied phenomenology*. MIT Press.
- Schacter, D. L., Benoit, R. G., & Szpunar, K. K. (2017). Episodic future thinking: Mechanisms and functions. *Current Opinion in Behavioral Sciences*, 17, 41–50.
- Varela, F. J., Thompson, E., & Rosch, E. (1991). *The embodied mind: Cognitive science and human experience*. MIT Press.
- Vygotsky, L. S. (1978). *Mind in society: Development of higher psychological processes* (M. Cole, V. Jolm-Steiner, S. Scribner, & E. Souberman, Eds.). Harvard University Press. <https://doi.org/10.2307/j.ctvjf9vz4>
- Wilson, M. (2002). Six views of embodied cognition. *Psychonomic Bulletin & Review*, 9(4), 625–36. <https://doi.org/10.3758/bf03196322>