

Human evolution, social learning and contemporary schooling

# Dr Robert Stevens [[1]](#footnote-1)

# Introduction

In his recent book *The Evolved Apprentice* Kim Sterelny ([Sterelny, 2012](#_ENREF_8)) argues that the accumulation of social learning (learning in a social context) was one central causal factor in the evolution of human uniqueness. He also argues that:

“Human cognitive competence is a collective achievement and a collective legacy; at any one moment of time, we depend on each other, and over time, we stand on the shoulders not of a few giants but of myriads of ordinary agents who have passed on intact the informational resources on which human lives depend.” ([Sterelny, 2012](#_ENREF_8))

“Human cognitive competence often depends on epistemic [or knowledge] engineering: on organizing our physical environment in ways that enhance our information-processing capacities…. Adaptive thinking depends on an adapted environment.” ([Sterelny, 2012](#_ENREF_8))

Sterelny does not elaborate on the implications of his views for contemporary schooling. In this paper I will describe Sterelny’s reasoning behind each of these key messages and their implications for contemporary schooling policy and practice.

# Social Learning as an inheritance mechanism

Sterelny recounts that Hominins - the group consisting of modern humans, extinct human species and all our immediate ancestors - split from the chimpanzee lineage around six million years ago, and over the last three million years, have sharply diverged from those of the great ape – chimpanzees, bonobos, gorillas and orang-utans. Hominins became fully bipedal, dependent on technology and cooperation. Their life history changed with a lengthy adolescence and active post-menopausal females. Hominins’ geographical range expanded as did population size. They acquired new cognitive capabilities such as language and abstract thinking ([Sterelny, 2012, p. 1](#_ENREF_8))

Sterelny argues that the evolution of accumulating social learning was one central causal factor in the evolution of human uniqueness. ([Sterelny, 2012, p. 23](#_ENREF_8)) Sterelny claims that *The Evolved Apprentice* is at heart an attempt to explain the origin and special role of cultural learning (or social learning) in human evolution. It can also be seen as a 200,000 year history of public education.

Sterelny claims that Hominins evolved **new inheritance mechanisms** not just new phenotypes. (A phenotype is the composite of an organism's observable characteristics or traits – such as eye colour.)

Early hominins resembled their parents in large part because *genes travel across the generations*, in part because children learned from their parents.

Late hominins resembled their parents in part because genes travel across the generations; in part because the preceding generations engineered the developmental environment of the next generation, and in part because information, mediated by social learning, flows from one generation to the next. **These multiple inheritance mechanisms transformed human evolutionary regimes.** ([Sterelny, 2012, p. 23](#_ENREF_8))

Sterelny argues that the expansion of cross generational cultural learning in the human lineage is the core cause of phenotypic differences between humans and the great apes. This is not to suggest that social learning is somehow a key innovation. Sterelny insists that there is no key adaptation or magic moment in human evolution. Rather, we evolved via co-evolutionary interactions among a suite of cognitive, behavioural and social capacities. Social learning co-evolved with and depends on:

* information pooling. Sterelny comments “We are obligate, habitual, inveterate, and adapted social information pumps sucking information and expertise from our social partners.”
* Ecological cooperation - collective action, coordination and division of labour.
* Reproductive cooperation - Humans cooperate reproductively. Children depend on adult protectors and carers (and not exclusively grandmothers or females). ([Sterelny, 2012, p. 72](#_ENREF_8))

In 1916 John Dewey alluded to education as being an inheritance mechanism.

The most notable distinction between living and inanimate things is that the former maintain themselves by renewal…With the renewal of physical existence goes, in the case of human beings, the recreation of beliefs, ideals, hopes, happiness, misery, and practices…. Education, in its broadest sense, is the means of this social continuity of life…. Society exists through a process of transmission quite as much as biological life. This transmission occurs by means of communication of habits of doing, thinking, and feeling from the older to the younger. ([Dewey, 1916, pp. 2-3](#_ENREF_2))

According to Sterelny, s*ocial learning comes first followed by adaptations for learning.* Phenotypic variation and plasticity is central to and the driver of evolutionary change. Genes are followers rather than leaders in evolution. If environmental change persists, there is likely to be genetic adjustment to it – initially by selection of existing variation and eventually supplemented by new genes. For example, the invention of writing (an environmental change) pre-dated the ability to read silently to oneself.

Why did social learning come to play such a key role in human evolution? Cultural learning played a core role in hominin life, in part because humans and their ancestors lived in changing worlds. Social learning has been important because hominins have needed to know so much. Change has not only been pervasive it has been multi-dimensional. Hominin social environments have changed in size, degree of division of labour, life history, patterns of inter group relations, forms of hierarchy and power relations within groups, sexual division of labour and the role of norms and ritual. ([Sterelny, 2012, p. 23](#_ENREF_8))

By 200,000 years ago human children had a lot to learn. The result has been a revolution in the nature and role of social learning in Hominin life and the evolution of a cluster of adaptations that support such learning. Social learning complements the development of social foraging – the evolutionary niche of late hominins.

## Social learning as public education?

It would be fair to describe social learning as characterised by Sterelny as public education in that social learning involves children learning not exclusively from their parents, but other adults of their parent’s generation. It shifts responsibility for the education of children from the private (family) domain to the public domain.

Sterelny suggests that early hominins largely acquired procedural information from their parents – they acquired parental skills. Late hominins learned about much more, they acquired from the parental generation much more declarative information. As capacities for social learning evolved, late hominins learned socially some of the tools for social learning itself, for example language – itself a public artefact.

The social environment became increasingly organised or engineered to support the flow of information across the generations. Learning became supported by provision of *public* resources to children, giving them the opportunity (time and space) to explore and adsorb and practice skills. They were protected by adults other than their parents ensuring that their trial-and-error exploration was safe. Social learning was enhanced by tolerating inquisitiveness about adult activities, by allowing them opportunities to explore the adult world, and providing children with advice.

## Investment in public education then and now

Our pre-human ancestor communities invested heavily in public education as responsibility for education of children shifted from parents to other adults. Today, many societies seem reticent to invest fully in public education, insisting that the individual or their parents should contribute to the costs of their own or their children's education. Accordingly, education is increasingly coming to be treated as a commodity.

Michael Sandel ([Sandel, 2012](#_ENREF_6)) laments that “we live at a time when almost everything can be bought and sold. ([Sandel, 2012, pp. 5-6](#_ENREF_6)) Sandel argues that some of the good things in life are corrupted or de-graded if turned into commodities.

He suggests the inroad of market values into schooling has the potential to corrupt the public or common character of schooling.

Similarly, the marketisation of schooling can promote the extrinsic value of education over the intrinsic value of learning. It can also promote the private value of education as a commodity over the public value of education in the promotion of a humane, people sensitive democracy. ([Nussbaum, 2010](#_ENREF_4)) Marketisation can undermine what Americans call the liberal arts education, and an imbalance of education towards the sciences rather than the arts and humanities – a trend documented by Martha Nussbaum in Not for Profit. ([Nussbaum, 2010](#_ENREF_4))

Too little public investment in education may impede our evolution, and limit our success in the challenges we face. As already mentioned, by 200,000 years ago human children had a lot to learn. Today human children have a lot to learn. 200,000 years ago our ancestors were constructing a social or cooperative foraging niche – a hunter-gatherer life way. Today we are constructing a new niche. Our societies have evolved in ways that more resemble insect societies – such as ants or bees – than the societies of our nearest living relatives. Humanity is evolving into a planet-sized superorganism similar to a leaf cutter ant society but with massively more complex divisions of labour. ([Stevens, 2015](#_ENREF_9)) Leaf cutter ant societies have around 20 different occupations (leaf harvester, leaf gatherer, gardener, nest protector, nurse etc). Human societies have thousands of occupations – growing exponentially, and unpredictably. If we are to successfully negotiate the transition to a superorganism, our children will indeed have to learn a lot, including less hierarchical ways of organising labour. Leaf cutter ants have worked this out over millions of years. Humans still have a social legacy of hierarchy that is in tension with a smoothly functioning superorganism – especially a planet-sized one. Meeting a challenge as formidable as this one requires an unqualified public investment in education.

# Extended and scaffolded cognition

*The Evolved Apprentice* is in part an investigation into the nature of the mind. One of the key messages is that “Human cognitive competence often depends on epistemic engineering: on organizing our physical environment in ways that enhance our information-processing capacities…. Adaptive thinking depends on an adapted environment” In other words, human cognitive systems are *extended*, that is, contain components that are external to the body. ([Clark & Chalmers, 1998](#_ENREF_1)) They are also embodied; the brain is not the sole cognitive resource we have available to us to solve problems. ([Wilson & Golonka, 2013](#_ENREF_11))

This epistemic engineering is almost always accomplished through the use of technology, whether it be tools such as knives, scrapers, axe-heads, spears, various vessels for eating and drinking, at different stages of their construction or graphical programming environments such as Scratch, Alice, Game Maker, Kodu and Greenfoot ([Grover & Pea, 2013](#_ENREF_3))

Kim Sterelny develops a case for what he calls “scaffolded cognition”, drawing on a theory of niche construction that places great weight on the role of the environment in supporting and amplifying cognitive competences ([Sterelny, 2010](#_ENREF_7)). These models emphasise the active role of the agent in explaining the adaptive fit of agent and environment. Over time, agents (or, more exactly, lineages of agents) adapt to their environments. But they also adapt their environment to them. Epistemic action (e.g. problem solving) is a form of niche construction too. Agents alter the informational character of their environment in ways that make crucial features more salient.

Niche construction often has cross-generation effects. Nests, burrows and beaver lodges are often reproductive resources, not just adult shelters. Humans profoundly modify both the physical and the informational environment of the following generations through teaching and learning in both informal as well as formal contexts (such as schooling). Thus capabilities develop in an information rich world that is adaptively organised to foreground that information. Cognition is socially supported. Over time inner mechanisms have coevolved with and adapted to this rich milieu. Language and arithmetical notation enhance our capacity to think, even when we do not have external resources to hand since we internalize these resources (e.g. through mental arithmetic or internalized speech).

This segues to another key message of *The Evolved Apprentice* that human cognitive competence is a collective achievement and a collective legacy.

Sterelny notes that the cases most commonly cited of extended cognition are highly focused on individuals. Sterelny writes “The poster examples in the extended mind literature have typically been individually used props: paper drafts, a mathematician’s working notes on paper or whiteboard and an architect’s first sketches.” Sterelny notes that these examples can be misleading, as human problem solving activity is often social and much more dependent on communal resources. The division of cognitive labour is of central importance in explaining both the acquisition and the exercise of many cognitive competences. Many academic projects depend on collaboration and on technical and specialist support. Other agents are often important resources for our cognitive projects: cueing, demonstrating and advising. But even those sympathetic to the extended mind model rarely treat other agents as part of an extended mind.

Given our definition of extended cognition (human cognitive systems as containing components that are external to the body) there is no good reason why these vital resources should not be regarded as components of cognition, and thus become canonical cases of extended cognition. Our minds are not as separate as we are sometimes apt to imagine. Our lives and our minds are deeply interconnected.

Perhaps the fact that most of the poster examples of extended cognition have been individually used props tells us something more about the philosophers conceiving these examples - and their competitive and individualistic academic milieu – than anything about the nature of the mind. Perhaps it is an accident of intellectual history.

Sterelny observes that tools for learning and thinking play a crucial role in human cognitive evolution and performance. The invention of numerals, and of systems of numerical notation, enabled humans to think about quantity in ways that were previously impossible. We came to be able to represent and reason about large numbers with precision. Material symbols enhance memory, so do various other external prompts. Many important cognitive capacities are like literacy: they depend on material culture and exist only in environments in which they are supported. Such tools become especially important **when environments change at rates that render obsolete the expertise of the parental generation**. In such fast changing domains, our capacity to navigate novelty depends heavily on cognitive tools. We use epistemic technology to organise and store information in accessible and user-friendly forms and simplify our information environment (a desktop interface) and we use technology to lower the costs of exploration.

Sterenly’s observations are commensurate with activity theory, particularly in its focus on tool (or artifact)-mediated activity. The ability to navigate novelty, support planning and thinking about new innovations, explore “possible worlds” and ultimately further our evolution is made possible through tertiary, imaginary artifacts.

These tertiary artifacts arise from the manipulation of physical (first tier) and semiotic or representational (second tier) artifacts, as suggested by Wartofsky (1979). In relation to information and communication technologies, tertiary artifacts represent a blending of digital tools and communities – as experienced through social media. Examples of these tertiary artifacts are the emergent activity patterns resulting from the documentation of large-scale events, such as natural disasters, political unrest, and activism. These activity patterns both create and recreate the nature of these events in unpredictable ways which have the potential to alter our experience and understanding of them. Being able to appreciate the mediating power of these digital tools constitutes a form of meta-awareness; fostering this meta-awareness is critical to the continued survival of our species (Oviatt, 2014). From an educational perspective, incorporating opportunities for reflection about how we use these tools in ways that alter our perception of what is being documented provides an authentic and engaging avenue to develop students’ critical thinking skills. These discussions should happen in the context of curriculum topics that relate.

Digital tools should be understood as just that – tools – which are used in contextualized and socially situated ways as people interact with each other and their environment. They are of greatest value when they are being used to learn new content, work on difficult tasks, hypothetical scenarios and solutions requiring innovation (Oviatt & Cohen, 2010). As such, when incorporating technology in the classroom, they should be used in non-trivial and non-redundant ways. As much as possible, tools should be selected that are flexible, mobile, and with adaptive interfaces. They need to be used collaboratively, not in isolation, so that the greatest benefit can be derived through social learning.

# The apprentice model of learning

Sterelny argues that while sometimes social learning is direct such as asking someone and getting a straight answer, the most consequential cases of social learning in humans have not depended on pure demonstration or instruction. Most social learning is **hybrid learning**: agents acquire skills through socially guided trial and error and socially guided practice. Children get advice, instruction, and other informational head starts from others, **but they get this support while engaged in exploratory learning in their environment**.

Skill acquisition in forager societies is often similar to apprentice learning. It combines information from the social world with information from the physical-biological environment. It is *learning by doing* – *in an environment seeded with informational resources* – raw materials, full and partial templates of final products, tools. There are many opportunities to learn by observing highly skilled practitioners. Advice is often available from both experts and peers for learning is often social and collaborative. The learning trajectory of an apprentice is often at least partially organised by experts. The expert organises trial-and-error learning of the apprentice by a combination of task decomposition and ordering skill acquisition so that each step prepares the next – assign tasks up to but not beyond their skill level - adaptive structuring of the learning environment.

It is in the interests of the expert to get as much work as possible out of the apprentice, so it is in expert interest to assign tasks up to, but not beyond their skill ceiling (with the help of adult or peer). The expert needs to assign tasks in what Vygotsky calls the Zone of Proximal Development - the difference between what individual learners can do or understand on their own, and what they can achieve with the help of a more skilful peer or adult. ([van den Broek, 2012, p. 6](#_ENREF_10)) Thus apprentice learning depends on individual cognitive adaptations for social learning and adaptively structured learning environments. **This mode of social learning has deep roots in hominin history.**

Apprentice learning does not require explicit instruction or formalised institutions. While the role of explicit teaching in traditional societies is often quite limited, adults can and do structure and engineer the learning environment. ([Sterelny, 2012, p. 36](#_ENREF_8))Teaching often consists in enriching the learning environment as well as direct instruction.([Sterelny, 2012, p. 37](#_ENREF_8))

In many forager societies children learn by doing – part of adult conversational circles – children often learn craft skills by first helping their adult relatives, combining practice with observation; again learning by doing, but with skilled adults organising the sequence with which skills are acquired.

Foragers do deliberately teach their children – but in the absence of such explicit teaching, children are supported with informational resources, and learn in an enriched environment. ([Sterelny, 2012, p. 39](#_ENREF_8)) The upstream generation structures the learning environment of the downstream generation, so that trial-and-error learning combined with observational learning and (sometimes) explicit instruction results in the reliable reacquisition of expertise.

The “apprentice model of learning” could perhaps more accurately be referred to as the “hybrid” model of learning emphasizing a combination of direct instruction with inquiry-based or student-centred approaches. The OECD states that to improve learning in school classrooms policies need to ensure that schools promote the use of a balanced combination of student-centred instruction with aligned curricular and assessment practices.

The OECD recommends that both direct and student-oriented instruction methods should be used. Direct instruction is built around problems with clear, correct answers that can be learned quickly. Student-centred instruction is associated with the teacher facilitating students’ own inquiry by allowing them time to find their own solutions to problems. The OECD observes that while there is no consensus in the literature on which approach is better, *an over-reliance on either approach is not recommended*. ([OECD, 2012, p. 138](#_ENREF_5)). Inquiry based approaches allow for learners to be teachers, and to innovate and develop new ways of doing things.

The apprentice or hybrid model is at odds with what might be called the “jug and mug” model of teaching and learning that we can make students learn by having the teacher stand at the front of the class, perhaps writing on the blackboard while transmitting information that students are supposed to remember. The teacher speaks; the students listen. Assessment involves tests and recitations and other ways of proving that students remember what they were told.

# Implications for contemporary schooling

The apprentice model has a number of virtues:

* It reminds us that teaching and learning is, like an apprenticeship, work and that pedagogies are a combination of labour between teacher and student using technology
* The apprentice model is a “middle way” between two extremes of didacticism and discovery learning
* The model sheds useful light on the way in which technology can be integrated into teaching and learning. On the apprenticeship model technology is used to seed the learning environment with informational resources. Information and communications technologies, as their very name suggests, provide a useful medium with which to seed the learning environment with informational resources.
* The Apprenticeship model has a family resemblance to design-based learning. Students work on a design challenge (e.g., a robot) that requires some critical knowledge or skills to be learnt. The design project constitutes an authentic, meaningful context where students learn to make connections with prior knowledge, ask questions, identify relevant knowledge, and discover and practice new scientific concepts. The design process involves investigation, planning, and design, providing rich learning experiences with construction failures as opportunities to revise and correct ideas. Teachers leverage off the design practice to discuss their decisions, to listen to and reflect on the design rationales of others, to identify what else they need to learn, and to understand the concepts that allow them to come up with better solutions. ([van den Broek, 2012](#_ENREF_10))

It might be argued that that was then and this is now. An apprenticeship or hybrid model may have been appropriate 200,000 years ago, but that does not show it is relevant now. In reply, I would suggest that the situation 200,000 years ago bears important similarities to current day realities in that children had a lot to learn, at both times humanity was/is in the process of constructing new niches – social foraging 200,000 years ago and eusocial (ultra-social) design in the present day. We and our ancestors lived in changing worlds. Change 200,000 years ago, as today, was intense, pervasive, persistent and multi-dimensional. For our ancestors’ environments as for our own – they were variable over space and time. Social environments in both eras changed in size, degree of specialisation, life history, patterns of inter-group relations, forms of hierarchy, sexual division of labour. Dealing with these changes required children needing to learn much. Environments then as now change at rates that render obsolete the expertise of the parental generation. Then, as now, we face wicked problems - inherently resistant to a clear statement of the problem and resistant to a clear and agreed solution.

Furthermore, if Sterelny is right, apprenticeship learning runs deep in human history. We are likely today to be genetically adapted to learning by doing, since genes follow persistent social changes. Learning by doing could, for this reason, be a more ‘natural’ way of teaching and learning.

# Conclusion

Education, as an inheritance mechanism, is of vital importance – it has made us what we are. It should be fully funded publicly. If it is not there is a risk that it becomes corrupted, and loses its impact as an evolutionary force. The apprentice model of learning is as relevant today as it was 200,000 years ago. Indeed it is a positive legacy of our pre-human ancestors, deeply embedded in our genes. If we are to meet the challenges of the future as effectively as our pre-human ancestors did, we may need to learn from them about how to learn.

# References

Clark, A., & Chalmers, D. J. (1998). The Extended Mind. *Analysis, 58*, 10-23.

Dewey, J. (1916). *Democracy and Education: An intrduction to the philosophy of education*. New York: The Free Press.

Grover, S., & Pea, R. (2013). Computational Thinking in K-12: A Review of the State of the Field. *Educational Researcher, 42*(1), 38-43.

Nussbaum, M. (2010). *Not for profit: Why democracy needs the humanities*. Princeton, New Jersey: Princeton University Press.

OECD. (2012). Equity and Quality in Education: Supporting Disadvantaged Students and Schools.

Sandel, M. (2012). *What Money Can't Buy: The moral limits of markets*. London, England: Penguin Books.

Sterelny, K. (2010). Minds: extended or scaffolded? *Phenomenology and the Cognitive Sciences, 9*(4), 465-481. doi: 10.1007/s11097-010-9174-y

Sterelny, K. (2012). *The Evolved Apprentice*. Cambridge Massachusetts, London, England: The MIT Press, A Bradford Book.

Stevens, R. (2015). *Eco Ethics*. Sydney.

van den Broek, G. S. E. (2012). Innovative Reserach Based Approaches to Learning and Teaching. (EDU Working paper 79).

Wilson, A. D., & Golonka, S. (2013). Embodied Cognition is Not What you Think it is. *Front Psychol, 4*, 58. doi: 10.3389/fpsyg.2013.00058

1. In gratitude, I acknowledge the contribution of my colleague Liliana Ructtinger to this paper. Liliana inspired my interest in embodied and extended cognition in the first place and the paper has been greatly enriched by her comments and the discussions we have engaged in throughout 2015. [↑](#footnote-ref-1)