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Introduction: *Learning sciences at the threshold of expansion*

HISTORICAL PERSPECTIVE ON THE LEARNING SCIENCES

The notion of the learning sciences is relatively new. A group of cognitive scientists in the United States initiated and founded the *Journal of the Learning Sciences (JLS)* in 1991. Janet Kolodner, the first editor of the journal, recounts the beginning as follows.

> It was Summer 1989 when Roger Schank, Allan Collins, and Andrew Ortony began work on making a new journal happen. Many in the cognitive science community felt it was time to start a new journal–one devoted to understanding learning and its implications, especially in the real world, and that would be open to publishing big ideas and out-of-discipline groundbreaking work in the area. They convinced LEA [Lawrence Erlbaum Associates] to publish the journal and went about the task of finding an editor. The Cognitive Science Conference in 1989 was where much of that work was done. (Kolodner, 2000, p. 1)

About ten years later, also the International Society of the Learning Sciences (ICLS) with its regular conferences was founded. Today the notion of learning sciences is relatively well established in the academia, somewhat the same way as cognitive science became established about fifteen years earlier.

From the beginning, research in learning sciences has been to a large extent focused on learning in schools and other settings of formal instruction. However, already in the first editorial of the *JLS,* Kolodner pointed out that a wider perspective was needed.

> Addressing problems in both education and training requires us to develop models of learning in real-world situations. If we find out how people learn in natural situations, we can create educational

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environments more conducive to learning. The same knowledge, in addition, will help us to design more informative museum exhibits, to write books in more interesting ways, and to interact with our peers and children in ways that promote natural learning. (Kolodner, 1991, p. 2)

In spite of this commitment, extending the scope of the learning sciences to include learning outside classrooms has been problematic. In her farewell editorial in 2009, after serving nineteen years as editor, Kolodner wrote:

Most of the articles published even now focus on learning in class-rooms. But more and more, our readers and authors are studying learning outside of school – in the workplace, at home, in summer camps, museums, other informal learning environments, and so on. (Kolodner, 2009, p. 2)

In the same issue, Kafai and Hmelo-Silver, the incoming editors, restated the initial commitment.

While the original focus on learning in the domains of science, technology, engineering and mathematics education and formal K-12 education, and technology will continue, we need to include more research on informal settings and lifelong learning. (Kafai & Hmelo-Silver, 2009, p. 4)

The new editors launched a strand devoted to learning outside of school. Four years later, new editors stepped in. Perhaps not surprisingly, they again declared the familiar intention.

We look forward to studies of learning at all grade levels, including higher education, but also in community settings, workplaces, family life, museums, and play spaces, as well as the ever-expanding online and virtual worlds in which we socialize, create, inquire, and learn in ways that were unimaginable scant years ago. (Tabak & Radinsky, 2013, p. 5)

These statements span a period of twenty-two years. In the conceptual framework of activity theory, they may be interpreted as expressions of a persistent dilemma. We recently defined the notion of dilemma as follows.

A dilemma is an expression or exchange of incompatible evaluations, either between people or within the discourse of a single person. It is commonly expressed in the form of hedges and hesitations, such as "on the one hand [. . .] on the other hand" and "yes, but." In ongoing discourse, a dilemma is typically reproduced rather than resolved, often with the help of denial or reformulation. (Engeström & Sannino, 2011, p. 373)

The "yes, but" structure is nicely manifested in one of the statements of Kolodner (2009, p. 2): "Most of the articles published even now focus on learning in classrooms. *But* more and more, our readers and authors are studying learning outside of school (...)." Also Tabak and Radinsky (2013, p. 5) reproduce it: "We look forward to studies of learning at all grade levels, including higher education, *but* also in community settings, workplaces (...)." The "on the one hand...on the other hand" structure is exemplified by Kafai and Hmelo-Silver (2009, p. 4): "While the original focus on learning in the domains of science, technology, engineering and mathematics education and formal K–12 education, and technology will continue, we need to include more research on informal settings (...)."

Recurring dilemmas may be read as manifestations of an evolving systemic contradiction in the activity they stem from. Without plunging deeper into a historical analysis of the evolution of the learning sciences, I will put forward a hypothesis of the inner contradiction of this field of research depicted as a generalized activity system (Figure 1.1).

When an activity system is primarily riddled by persistent dilemmas rather than critical conflicts and double binds, it implies that the developmental cycle of the activity system is at the stage of a primary contradiction. A primary contradiction appears as something problematic and uncomfortable but not yet as a crisis that unavoidably demands transformative action and radical redesign. In Figure 1.1, I depict the hypothesized primary contradiction of the learning sciences in the form of two alternatives within each component of the activity system, e.g., in the object component as "Learning in classroom or learning in human life."
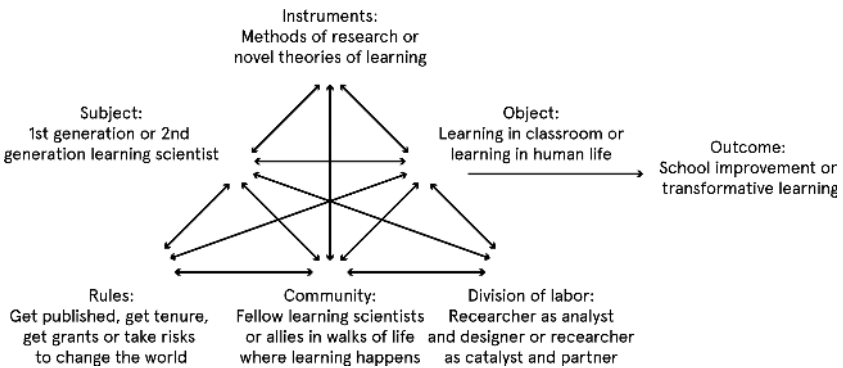
Instruments:
Methods of research or
novel theories of learning

Subject:
1st generation or 2nd
generation learning scientist

Object:
Learning in classroom or
learning in human life

Outcome:
School improvement or
transformative learning

Rules:
Get published, get tenure,
get grants or take risks
to change the world

Community:
Fellow learning scientists
or allies in walks of life
where learning happens

Division of labor:
Researcher as analyst
and designer or recearcher
as catalyst and partner

FIGURE 1.1. The inner contradiction of the learning sciences as a generalized activity system

The term "or" often implies mutually exclusive options. Here, however, it implies a growing need to make choices of direction that may in themselves not consist of mutually exclusive opposites (obviously a classroom is also a form of human life, so as such the two are not mutually exclusive opposites). What is at stake is the choice whether to stay in the familiar comfort zone or to break away into something new and risky, what I would call the zone of proximal development (Vygotsky, 1998, pp. 202–204; Engeström, 1987, p. 174).

In activity-theoretical discussions of contradictions (Engeström, 1987), the primary contradiction of any modern activity system is seen as a specific variation of the general primary contradiction of the socio-economic formation of capitalism, namely the contradiction between the use value and the exchange value of commodities. How is the primary contradiction of the learning sciences, schematically depicted in Figure 1.1, related to that general primary contradiction of capitalism? Actually the connection is not so hard to see. Take the component of rules in Figure 1.1. The comfort zone rules are straightforward exchange value: Get published, get tenure, get grants – in other words, keep your eyes on the external success markers when you conduct your research. The rules of the zone of proximal development are equally clearly use value: Take risks to change the world – in other words, keep your eyes on the needs of people when you conduct research.

Contradictions are tricky because one cannot simply choose one side and reject the other one. One has to take both and deal with their interplay and constant clashing. The expansive way out is to find and develop a platform that emerges as a qualitatively new opening and transcends the dualistic opposition.

HORIZON OF CONTRADICTIONS

As novel objects, instruments and rules enter the activity system from the outside, the primary contradiction will eventually transform into aggravated secondary contradictions. These will manifest themselves as increasingly serious disturbances and conflicts indicating growing mismatches between the way the activity system is functioning and the needs it should meet.

In the learning sciences, some indications of such mismatches may already be tentatively identified. Perhaps the most important one is the relative inability of the learning sciences to address the rapidly advancing commercialization, privatization and commoditization of education (e.g., Cooper, 2004; Macpherson, Robertson & Walford, 2014; Ravitch, 2014;

Shumar, 2013; Tilak, 2008). This powerful tendency treats knowledge as proprietary commodity that generates private profit. This tendency is bound to clash with another equally powerful tendency, namely the increasingly universal availability of knowledge and the increasingly pervasive potential of practically anybody to produce and effectively disseminate knowledge free of charge in the web and in various digital social media. Paradoxically, both tendencies are breaking down the protective walls around schools and school knowledge. The first tendency does this by bringing corporate actors and practices into schools and by involving students and teachers in market-oriented practices beyond the school walls. The second tendency does this by sucking students and teachers into the vast virtual worlds of web 2.0 and social media.

Another possible indication of a mismatch is the relative absence of what I have called "runaway objects" (Engeström, 2009b) in the discourses of learning sciences. "Runaway objects" or "hyperobjects" (Morton, 2013) are objects so massively distributed in time and space as to transcend localization, such as climate change or pandemics, Runaway objects have the potential to escalate and expand up to a global scale of influence. They are objects that are poorly under anybody's control and have far-reaching, unexpected effects. Such objects are often monsters: They seem to have a life of their own that threatens our security and safety in many ways. Runaway objects are contested objects that generate opposition and controversy. They can also be powerfully emancipatory objects that open up radically new possibilities of development and well-being. Humanity risks its own future if it does not learn to deal meaningfully with runaway objects.

A third possible indication of a mismatch is the weak recognition in the learning sciences of social movements as sites and subjects of learning. Although many social movements have led to durable cultural innovations and new types of organization (Rao, Morill & Zald, 2000), social movements are often relatively short-lived. This may lead learning scientists to dismiss them as mere temporary fads. That would be a serious mistake. As Soule (2012, p. 1721) points out, "social movement organizations are not bounded entities; rather they are embedded in a web of connections to other organizations (both within the movement and outside the movement)." This embeddedness makes many social movements much more durable than what they may seem at the first sight.

If communities of learning sciences are to cope with these types of mismatches and forces, they need to step out of their comfort zone. One might argue that this is exactly what is going on. I think the reality is more

mixed and contradictory. For example in the new edition of the *Cambridge Handbook of the Learning Sciences* (Sawyer, 2014), the last part of the volume is titled "Moving learning sciences research *into* the classroom" (italics added). It seems to me that the classroom is where most of learning sciences research has been sitting since its inception.

DIMENSIONS OF EXPANSION

The key indicator of expansive learning is the expansion of the object of the activity system involved in the learning effort. Three important dimensions of expansion of the object may be identified (Engeström, 2000; 2001b). These three are (1) the socio-spatial dimension, (2) the temporal dimension and (3) the political-ethical dimension of expansion. The first dimension deals with widening the circle of people and settings included in the activity. The second dimension deals with extending the time perspective of the activity toward the future and toward the past. The third dimension deals with making visible and questioning the taken-for-granted human and societal consequences of the activity as well as accepting agentic responsibility for those consequences.

How might these three dimensions be translated into challenges for the learning sciences facing their zone of proximal development?

The socio-spatial dimension may be translated into two challenges. The first one can be condensed into the question "Who are learning?" The challenge consists in a transition from a restrictive focus on individual learners to the inclusion of collectives as learners. The second challenge may be expressed by means of the question "Where does learning happen?" The challenge consists in a transition from a restrictive focus on classrooms to the inclusion of other settings and communities as sites of learning.

The temporal dimension may be translated into the question "What is the timeframe of learning?" The challenge consists in a transition from a restrictive focus on learning within lessons and curriculum units to the inclusion of longer-term processes and different rhythms of learning.

The political-ethical dimension of expansion may again be translated into two challenges. The first one can be condensed into the question "What is learned and why?" The challenge consists in a transition from a restrictive focus on given curricular contents to the inclusion of questioning and creating novel contents by different actors. The second challenge may be expressed by means of the question "What is the societal impact of learning?" The challenge consists in a transition from

a restrictive focus on learners as acquirers and participants to the inclusion of learners as agents of change.

The five challenges described earlier may be used as a lens to look at the development of the learning sciences in terms of articles published and topics addressed in research.

CONTOURS OF THE ZONE OF PROXIMAL DEVELOPMENT

What might be a potent initial idea or "germ cell" (Engeström, Nummijoki & Sannino, 2012) of the next generation of learning sciences? In a recent paper, James Greeno and I suggest the notion of expansivity as such a germ-cell idea. At least since the provocative theorizing of Bateson (1972), the idea of shifts between qualitatively different levels or types of learning has influenced researchers. The idea of shifts implies the possibility of a radical expansion of the scope and impact of learning in an activity system. Such expansive potential or expansivity is an important quality of learning in activity. (Greeno & Engeström, 2014, p. 132)

We point out the future-making potential embedded in the notion of expansion.

> The learning of new skills and concepts may is enhanced when those skills and concepts are not handled as isolated actions of answering "what?" and "how?" questions but are instead embedded in envisioning and constructing the structure and future of the entire activity system, that is, answering "why?" and "where to?" questions. (Greeno & Engeström, 2014, p. 133)

If the inherent expansivity of learning is taken seriously, the very idea of learning as a controlled process is shaken. The acknowledgment of expansivity means that we accept the possibility that learning gets out of the hands of the instructors and takes a direction of its own.

To be sure, expansivity can be construed in two ways. One way is to see it primarily as a cognitive quality, as the potential of learners to go beyond the information given, to paraphrase Bruner (1974). The other, more radical way to understand expansivity is to see it primarily in material and cultural terms, as the inherent potential of learning to produce new material objects, practices and patterns of activity. It is this second perspective that I promote in this book. The title "learning what is not yet there" implies the generation of novel material forms of collective life, not merely construction of novel ideas in the minds of the learners.

STRUCTURE OF THE BOOK

Chapter 2 of this book discusses the nature of the theory of expansive learning as a particular type of learning theory, namely a process theory of learning. The chapter proposes criteria for productive process theories of learning and examines the theory of expansive learning in the light of these criteria. Chapter 3 presents a review of research based on the theory of expansive learning and suggests areas of further research and development of the theory.

Chapters 4 to 8 contain a series of empirical studies based on the theory of expansive learning. Each one of these studies addresses a particular conceptual challenge or theoretical problem.

Chapter 4 examines expansive learning efforts in three workplaces, namely a bank, a primary care health center and a hi-tech manufacturing company. The chapter identifies two major theoretical ideas that enrich the theory of expansive learning, namely the idea of multi-level *instrumentalities* as mediators of work and learning and the idea of *experiencing* as a bridge between design and implementation in expansive learning.

Chapter 5 takes up the widespread notion of *learning environment* as a possible key concept of the learning sciences. A critical examination of this notion, coupled with an analysis of a collective transformation effort undertaken in a Finnish middle school, leads to the conclusion that framing the research in terms of learning environments tends to restrict the analysis and researchers might benefit from examining their settings in terms of activity systems.

Chapter 6 analyzes an expansive learning process carried out in the surgical department of a university hospital in Finland. In organizational change efforts, the conceptual starting points of *process* enhancement and *community* building are commonly regarded as alternatives, if not opposites. The analysis of the formative intervention conducted in the hospital leads to a model aimed at transcending this dichotomy by means of expansive learning.

Chapter 7 is a study of the unfolding of a process of expansive learning in a Change Laboratory intervention conducted at a university library in Finland. The chapter focuses on three key concepts, namely expansive *learning actions,* expansive *learning cycles* and unexpected *deviations* from instructional intentions. The analysis may be read as an implementation of the criteria for productive process theories of learning proposed in Chapter 2. It is also a methodological model for further detailed studies of the stepwise movement of expansive learning in different settings.

Chapter 8 tackles the challenge of sustainability and longevity of expansive learning. Consequences of expansive learning efforts undertaken some ten years earlier in two Finnish primary care health centers are traced and analyzed. A comparison of the two processes leads to a concept of *continuity* which is necessarily interrupted by *breaks.* The breaks may represent *mundane discontinuities* which can be mended by *bridging,* or they may represent *directional discontinuity* which typically leads to the evaporation or collapse of the expansive learning cycle.

Chapters 9 and 10 open up more future-oriented perspectives for theorizing and practicing expansive learning. In Chapter 9, I propose the concept of *wildfire activities* to describe and analyze poorly bounded and rapidly spreading activities that offer new possibilities for learning.

In Chapter 10, I sketch a methodological framework for *formative intervention* research aimed at facilitating and understanding the dynamics of expansive learning. The methodology of formative interventions is built on the principles of *double stimulation* and *ascending from the abstract to the concrete* which together make *transformative agency* a crucial quality and outcome of learning. This last chapter of the book is an open invitation to engage in joint efforts of building a theoretically ambitious, empirically rigorous and practically consequential interventionist methodology for the learning sciences (see also Engeström, Sannino & Virkkunen, 2014).