

ICT, LEARNING OBJECTS AND ACTIVITY THEORY

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It is an unsettled issue between research traditions how to attend to and eventually negotiate the implied rather than acknowledged dispute between individual agency and collective activity. On the one hand, the ability of an individual to take action has a positive effect on the functioning of a social system. Intention, initiative and entrepreneurship are praised self-controlled qualities. On the other hand, inter-subjective relations between people and reactions to another person's input are crucial for the main activity. This article clarifies part of the debate by drawing on experiences of digital software deployed for facilitating teaching and learning.

Introduction

Concepts like "human agentive consciousness", "private realms of subjects" and "reflexive agents" (López-Varela 2010, p. 125) cover a dualism of subjects ("producers") and objects ("consumers"). However, focus (ibid., p. 127) on "betweenness" and computer-mediated communication enable for analysis of intersubjectivity transcending individual and cultural-historical contexts. In a similar approach, Garrison (2001, p. 276) argues against dialectic thinking based on a list of dualisms first published in Dewey (1952/1989, p. 408) "The material and spiritual, the physical and the mental or psychological; body and mind; experience and reason; sense and intellect, appetitive desire and will; subjective and objective, individual and social; inner and outer; this division underlying in a way all the others." In responding to a philosophical approach to characterizing the functioning of the human brain or how we think, learn and memorize, Roth (2007, p. 40) acknowledges the *dialectical* as opposed to *dualistic* relation between individual initiative and collective influences. Kaptelinin and Nardi (2006, p. 11) specifically outlines agency versus structure for ICT environments, saying "activity theory has always had a strong notion of the individual, while at the same time understanding and emphasizing the importance of a socio-cultural matrix within which individuals develop." So, emphasis is on a combination of individual and collective influences on human behavior. The approach provides a productive venue for describing and explaining how people think, learn and know.

Regardless of approach there seems to be creative dynamics at work, because for any human meeting there is transaction between participants. Wells (2007, p. 165) labels such meetings an "occurrence of a joint activity in which multiple participants are collaboratively involved." It is intriguing to find that people seem to struggle with ongoing dilemmas and recurring contradictions without considering issues of agency and systems thinking. Also, conceptual analyses suggest that by agency we understand that individuals are free and willing to act on impressions, to take action, support activities and (re)act on other people's behavior. Our ability to act on personal needs and motives so as to control actions in Self and Other is a specific human ability, be it informed, planned or spontaneous. Furthermore the general idea for a human need to exercise agency is to produce an effect according to an original plan or an adjusted intention. On the other hand people seem to continuously build social systems in their minds whenever they listen to, calculate, process and respond to events, situations and other people, be it in physical, virtual or social worlds. Thus, any such social system – a football team, an army or an orchestra – is a community of practitioners with people relating to each other with a shared understanding of the limits of the system, what it takes to cross its borders, what the consequences would be, what keeps the community going and what separates insiders from outsiders.

Problem statement and purpose of research

Individual and collective input to shared activities operates differently, depending on the participants' behavior. Do they act from a self-managed and self-conscious low-level of consciousness, attention and intention or from a high level of professional thinking? An additional purpose would be to explore the potential of some activity theory concepts for teaching and learning, including verbal exchanges mediated by modern technology, i.e. sessions on a computer-based platform enabling for a study into group processes defined as a vehicle for higher order professional thinking. By engaging in verbal co-construction (co-operation, communication, co-ordination) of a collectively processed learning object (about how to use ICT), teachers seem to either learn/identify/explore a sought object or to remain at a low level of consciousness merely supplying requested curricular data on a given object. The result of their interactions depends on how the group interacts, who takes the lead, who is attentive and who drops out from the process. It seems as if those who struggle during the sessions contribute by a self-conscious input of mental information at the level of *object construction*. They dutifully complete each step of an interactive process. Those who contribute to productive group interactions generate professional thinking by the way they *instantiate the object* of inquiry. They initiate interactions by the way they understand and act out verbal input for raising the level of knowledge during object construction. During the process of transformation from merely interacting to actual transformation of a shared learning object there seems to be a delicate balancing of isolated individual and collectively shared needs going on.

It is a relevant mission to study if it is possible to apply general activity theory as an analytic resource for describing the catalyst mechanisms that inspire and/or sustain an emerging professional culture during e.g. ICT mediated sessions. On this note, Nardi (2007, p. 6) says Raeithel (1996) explained co-construction of a shared object like a series of verbal exchanges to mean "re-definition of the object of collective activity." Even today Engeström's (1987) original concept of co-construction of an object needs to be modified. Kaptelinin and Nardi (2006) say co-construction equals the traditional process of finding out what a subject expects of other subjects (object construction) plus exploration of how agents go about realizing other people's expectations (object instantiation).

Adding to the above, Nardi (1996, p. 69) introduce the problem of assessing properly individual and collective influences to human development in an ICT context asking "What are the relations between artifacts, individuals, and the social groups to which they belong?" Until now personal chemistry, compatibility of goals, interests or ambitions have mystified what happens when people cooperate in order to form rewarding activities. Concepts like luck, magic or fortune fail to provide an explanatory basis for any theory or method for exploring the formation and development of human activities. It is useful to put into perspective how human activities start off, change, develop and die out. The problem for research is to find mutually excluding variables that inspire and/or sustain productive acts, actions and activities between people, more specifically oral and physical relation-building mechanisms that inspire individuals and social systems to communicate through a medium, a boundary object (Van Oers, 1998) or a designed space for interaction (Winograd, 1996). The medium for this study is any "transformative artifact" or soft- and hardware together. The approach provides an interactive context for the users and the researcher equally to share physical, social, emotional and cognitive experiences. Following Van Oers (1998, p. 137), most soft- and hardware combinations could/should be understood as "a result of a personal (mental) or social act of interpretation of an activity setting (contextualizing), trying to bring the determining factors under control." In deciding if soft- and hardware plus routines is a process, an elaborate context or a tool (Ducheneaut and Bellotti, 2001), emphasis is on process, i.e. human interactions labeled group dynamics, functioning teams or virtual communities.

For some time now researchers have been obsessed with a basic dichotomy, *subject* versus *object*. Their misguided focus has had a confusing effect on theory-making. Today people consider what constitutes a good life, effective learning and valid knowledge from a different perspective. Collectively, we assume that subject and object are interrelated, complementary but independent forms of being, i.e. human ways of relating to the world. In this text I demonstrate a “practical turn” towards cultural-historical (socio-cultural) influences on Self, personality and consciousness as they provide a developmental path to follow. Conceptualizing of work/shared activity rather than individual reflection provides another way forward. On shared activity, Dewey (1916, p. 327) provides a synthesizing approach to the implied dichotomy between personal reflection and language systems “Overt action is demanded if the worth or validity of the reflective considerations is to be determined.” In this study I elaborate on Dewey’s (1953, p. 154) bold philosophical statement about what characterizes the human species “We are at root practical beings, beings engaged in exercise (to master nature; *comment by this author*). This practice constitutes at first both self and the world of reality. There is no distinction.” Before doing so, however, there is another aspect to consider.

For social, behavioral and organizational studies applies that researchers clarify input, process, effect and feedback mechanisms affecting human thinking, behavior, values and attitudes. Such approaches relate to human-organizational influences, reflecting an ambition in the researcher to identify and analyze driving, balancing and regulative forces on individuals, material progress and human growth. Soon enough a number of terms appear in opposing rather than dialectical pairs. Find ten specific conceptual constructs complementing Dewey’s (1952/1989) contribution.

Singular/plural; I/we; person/people; private/public; Self/Other; individual/collective; one-off/system; intention (need-motive)/ activity (organization); agency/structure; psychological/social; entrepreneurial/administrative.

The way we use these concepts on isolated or shared human behavior respectively entails a different perspective for each reference. For example, Bourdieu (1977) employs the pair *agency* and *structure* for specific purposes, a specific context and tradition.

In order to be able to assess the impact of individual versus collective input to verbal interactions, one purpose of research would be to track shifts in the situated activity (object construction) bringing higher order thinking into place. Another priority is to analyze an advanced conception of the discourses context (object instantiation) during the crucial moments when changes occur. Approaching the problem in this way enables for elaborating a theory of agency and structure, assuming changes come as a result of how subjects express (a) self-conception and self-management in a context of supplying factual information and (b) the effect of professional thinking which expands the participants’ knowledge about computer-mediated design and learning.

Previous research on agency and organization

Lev Vygotsky (1987) is an authoritative proponent of a synthesizing approach to agency and systems thinking. He suggested agency should be categorized by means of ‘scaffolding’, e.g. in mother-child relations. In doing so the researcher would enhance sought processes and outcomes of contextualized learning, for example by studying how mother and child finish a jig-saw puzzle. Peter Senge (1990) is a contemporary proponent of personal mastery in organizations, suggests management should help employees in their thinking about the company in terms of human relations, social system or learning organization. For contemporary purposes, it is a relevant question to ask: what is the position of organization theory? Rigg (2008, p. 105) argues for both-and-understanding of relations between *I* and *we*,

criticizing the *we-approach* because: “organizational or systemic capacity rarely goes beyond the notion of peers”. Rigg (ibid, p. 106) introduces the concept multi-agency partnerships (“collective subject” in Enerstvedt, 1977) but without clarifying the relations of such partnerships to either *I* or *we*. Vince (2004) provides another contribution to understanding organization theory, defining learning among employees as a collective process for inquiry into established practices. Hawkins and Chesterman (2004) praise intra-organizational *we*-teams compared to mixed *I*-centered groups. *We*-concepts denote patterns of social interaction while other authors characterize organization theory as void of theory. For example, Fletcher (1997, p. 94) says an organization is a discoursed framework of vaguely defined “interactively shared meanings”.

Miettinen (1999) presents action network theory (ANT) as an extreme form of theorizing about integration of human subjects and material objects. The major proponent of the theory, Latour (1994), says people and tools are “trapped” in an all-encompassing psycho-material network without natural boundaries, or social relations for that sake, between objects and actors. Leaving the extremes behind, Lee (1985, p. 68) notes that Vygotsky and Marx (1990) had several things in common regarding relations between objects and people. They emphasize situated activity rather than individual reflective acts. Their primarily shared idea was “showing what role or effect an item has in some system of which it is part.” In a politically relevant statement, on individual and society Vygotsky (2004, p. 343) says “We cannot master the truth about personality and personality itself so long as mankind has not mastered the truth about society and society itself.” Vygotsky (1998) holds that description and analysis should start with systems thinking because just like Engeström (1987) and Leontev (1978) he argues that the object of research is the system first and the individual second. He outlined intricate relationships between man and the world, suggesting a connection between the two for analysis of higher mental functions like generalization, abstraction and learning. Still, in another text Vygotsky (1998) opts for the crucial impact on human development by collective activity systems.

At first every higher form of behavior is assimilated by the child exclusively from the external aspect. [...] It is only due to the fact other people fill the natural form of behavior with a certain social content, for others rather than for the child himself, that it acquires the significance of a higher function. Finally, in the process of a long development, the child becomes conscious of the structure of this function and begins to control his own internal operations and to direct them. (p. 171)

In a comment to the above, Scribner (1985, p. 123) positions Vygotsky in the realm of systems thinking by referring to people’s need to “search for specifically human behavior in history.” There is a basic human need to relate to history. This is evident today. From a perspective of short human history, ethno-methodologists like Garfinkel (1967) study everyday activities and structured, orderly social behavior at length and in detail. But they lose out on cultural-historical influences. Participatory learning theory (Lave and Wenger, 1991; Rogoff, 1990) represents another disciplinary school, over-emphasizing the significance of context, collaboration, inter-subjectivity and discourse. Such “participatory learning theory” could help explore communications among members of narrowly defined groups in a limited ICT setting and an expansive Facebook- context. In clarifying complex relations between ecological humanity, contextual learning, systems thinking and agency, Bronfenbrenner (1970) offers a holistic approach to understanding what human activity systems are. Carefully defined analysis at micro-, meso-, exo- and macro-levels forms a resourceful basis for investigation of family, children’s networks, institutionalized schooling and culturally evolving value systems.

Engeström and Miettinen (1999, p. 9) follow the original focus and lineage of general activity theory. They define contextualized phenomena where people work together towards a shared goal in order to form a shared activity, or “object-oriented, collective and culturally mediated activity, or activity system.” In supporting an approach so attached to the idea of a collective subject, past proponents of Computer Supported Collaborative Work (Nardi, 1996) says “collective activity” is an analytical tool for understanding emerging contradictions during cooperative work. Today similar theories refer to virtual communities of practice, social media, virtual teams or net-based societies.

It is comparatively easy to outline the dialectic differences between agency and structure by juxtaposing the constructs individual agency and collective subject(s). The reason is that a propositional antithesis to “collective culture” aims at promoting individual agency. Kaptelinin and Nardi (2006, p. 247-248) resolve the dichotomy by providing an enriching analytic potential of concepts related to agency, suggesting there is (a) need-based agency as in biological and social needs; (b) delegated agency for acting on someone’s behalf; (c) conditional agency as when actions produce unintended effects. Specifications of agency bring us one step closer to understanding how the human species learn to relate to work activity, other people and the world.

Long before it became necessary to fine-tune the operational meaning of *agency*, any notion of humanity carried with it the idea of initiative, fostering, agency or intention. It is equally true that a single-minded materialistic approach to how the human mind functions form disconnected approaches as to how the world works in a more unique and general way for the human sciences. For some time, activity theorists were under the influence of natural science writings. Hegelian (1904, p. 269) conceptions of the individual industry worker in the realm of Marxism reveal a self-centered view of man, of the new man: “If man saw [...] that whatever happens to him is only an outcome of himself, and that he only bears his own guilt, he would stand free.” Marx (1990, p. 177) complements Hegel’s description of modern man as an outcome of his own labor, saying (ibid, p. 271) man is “the architect of his own future with an ability to master the laws of his own formation.” From a perspective of a general law governing man’s historical development, people held the opinion that modern man must become a self-controlled agent of any line of development – an inspiration originating from Engels (1966, p. 302) prognosis: “The objective, external forces which have hitherto dominated history will pass under the control of men themselves. It is only from this point that men, with full consciousness, will fashion their own history.”

In realizing the roots of this emphasis on individual within a group, Bruner (1987, p. 15) says Vygotsky effectively confronted concepts like freedom, necessity, agency and causality “because he [Vygotsky] was so dedicated to the concept of self-regulation.” Vygotsky himself (1997, p. 166) says: “[Individual] Thought plays the part of an advance guide of our behavior.” On relations between intentionality and mediation facilitated by studies into ICT, Kaptelinin and Nardi (2006, p. 10) take on a neutral stand, continuing “*people act with technology, [...] as subjects in the world.*” saying (ibid, p. 33) agency is: “an ability to act in the sense of *producing effects* and an [...] *ability and need to act*. There is, however, a risk of confusion between current trends in ICT and general activity theory because agency and intentionality are near synonymous concepts. But without similarities there would be no meaningful differences to comment on. On agency, Vygotsky (1986) outlines the characteristics of a stepwise process, in fact an advancement of intentionality comprising the individual mental steps preceding an action. By referring to an example of how children become conscious of their intentions when they sketch a drawing, Vygotsky observed that at early age the child simply draws. Then the child labels the picture after drawing it. Finally the child makes up a plan before drawing. Miettinen (1999, p. 177) echoes Vygotsky’s example of intentionality, saying that if adults could only break their direct, spontaneous and instrumental relation to objects, they would be able to imagine, plan and visualize a different future. It is far from clear,

however, how the suggested shift from one relation of a certain type to another relation with a different kind of (i) learning object or (ii) object of work would look like. Kuutti's (1991) quick-fix proposal about how to understand agency and mediation suggests a middle way between confusion generated by unspecified influences between natural and social resources (context) and recurring circles of personal initiative plus cooperation (activity). A minimal context for individual action appears in yet another way by means of relating individual agency to organizational development.

Assessing the quality of research

The purpose of this outline is to mediate between individual and collective extremes and provide a dialectic synthesis between individual agency and organizational structure. A close reading of Vygotsky (2004) verifies to a dualism in the history of past and in present day research. Many approaches to understanding conscious agency versus structured systems thinking reflect a harmful dualism between intentional Psychology and materialistic quantification, the former stressing needs, motives and agency and the latter emphasizing quantitative data and statistics.

Recurring misconceptions abound. In commenting on the relation between man and environment, Hodkinson, Biesta and James (2008, p. 33) say: "Any place where people act and interact has a learning culture, where learning of some type takes place." Their (ibid, p. 34) rhetoric argument suggests "Cultures are (re)produced by individuals, just as individuals are (re)produced by cultures." They (ibid, p. 30) claim that their objective is to develop a theoretical framework, but they confuse the relations between individual psychology and social control by aggregating to their theoretical basis neighboring, but fundamentally different, approaches like Billett (2008) on workplace learning, Vosniadou on representations or Bourdieu (1977) on philosophy. Their attempt (ibid, p. 30) at explaining the characteristics of ICT cultures vs. providing a cultural historical account of learning "from a broadly situated socio-cultural perspective" turns into analysis of abstractions like expectation/motivation vs. need/motive (ibid p. 34). Also, they fail to clarify how theoretical development could emerge from resident relations between e.g. culture, behavior, context, process, objective or outcome. Moreover, they claim they contribute to theoretical development on analysis of empirical data. Without actually doing so, they (ibid, p. 37) quote Lave (1996, p. 162) saying "Researchers would have to explore each practice to understand what is being learned and how." However, the authors corrupt their explicit mission to integrate individual agency and collective systems. I fail to see an explicit link between their diverse list of items in distantly related theories. Vygotsky (1987), on the other hand, provides a reflected and empirically verified statement about the operational relation between thought and action, i.e. intentional and structural conditions defined as context.

In subjecting to his will the process of his own reactions, man enters in this way into a substantially new relation with the environment, comes to a new functional exploitation of elements in the environment as stimuli-signs which he uses, depending on external means, and directs and controls his own behavior, controls himself from outside, compelling stimuli-signs to affect him, and elicits reactions he desires. (p. 63)

Yaroshevsky (1989, p. 80) compliments Vygotsky's ambition to integrate a person's unique life with the development of mankind perceived as a social system. In order to do so, the researcher must be able to weave "the individual's brief life into the great age-long history of social being [combining] the macroscale of the life of the people down the ages and [...] the microscale of the individual's routine contacts with his brethren." Such a synthesizing approach is a valid design because people believe that consciousness is an individual quality. Vygotsky (1999) also argues that consciousness is in the social moment, on time and in place. Leontev (1978) is equally clear on the issue, stating that there is only activity defined as a relation between an agent (i.e. in his case a collective subject) and the object towards which the action is

directed. Leontev's main concern is to explain relations between needs-motive-activity, a line of research beside the immediate purpose of this study. Sure enough, subjects and objects acquire characteristics/properties when human activities are enacted on/with/by individuals. Kaptelinin and Nardi (2006, p. 31) adopt a balanced transformational view of relations between people and technology, saying the purpose of activity theory is to "understand individual human beings, as well as the social entities they compose." They (ibid, p. 37) conclude "A key factor of an individual's success is the success or failure of the social entity [...] to which the individual belongs." One could add success of the social entity in achieving initiative, change, learning and development. ICT contexts will prove helpful in explaining such processes. A shift is underway, going from self-contained psychological analyses toward an emerging focus on models which include collaborative and communicating groups of people on social media.

In finding a solution to the harmful separation between influences of individual and/or collective co-construction of a learning object by means of general activity theory, Moll (1990, p. 1) says there is a "cognitive gap" between singular and collective extremes. Unfortunately recent research seems reluctant to clarify how individual input contributes to collective co-construction of meaning in digital environments. For example, Rydberg and Christiansen (2008, p. 209) argue that during interactive processes, the interlocutors participating in a *learner centered design* (Gifford and Enyedi, 1999) gradually feel "invited to mimic" each other's behavior, "spread the knowledge" or "formulate new rules". Likewise, Levin and Wadswanly (2008, p. 234) say co-construction equals "cognitive transformation", a definition merely confusing a limited aspect of the concept because co-construction of a learning object is a complex, interactive and rewarding process.

Mediating individual and collective influences

The concept object (of activity) serves as a means to bridge between agency and structure. Leaving the basics (subject, object and instrument) of activity theory behind, "relations" plus "object of activity" make up a comprehensive analytical framework. The reason is that - with an eye to individual consciousness about the existence of Self - Vygotsky (1994, p. 19) emphasizes interaction between person and environment, quoting Karl Marx: "My relationship to my environment [...] is my consciousness." And as the title of Leontev's (1978) main work *Activity, Consciousness and Personality* suggests, the first is a precondition, the second is a process and the third is an ultimate achievement of cooperation. Following Leontev's trajectory on development of activity systems enabled by/enabling a "collective subject", agency relates to systems thinking, almost like singularity relates to multiplicity.

So far quotes and comments emphasize agency as an impetus to development. But one would prefer an explanation with a focus on a transformational move from structured activity pushing forward in a learning curve aiming towards agency. Galperin says (Arievitch, 2003, p. 279) it is necessary to analyze the "culturally constructed nature of mind without losing the aspect of individual psychological functioning." It is, however, an unsolved problem (ibid, p. 281) how "mental, psychological emerges out of material, nonpsychological." Another equally difficult suggestion to grasp points to the need to envision a transitional move between singularity and pluralism during shared activities. Galperin's (ibid., p. 284) argument is that people should "understand individual mental development as the gradual internalization and transformation of socially constructed shared activities." By pointing to the object-relatedness of human activity, i.e. a collective object of activity, Galperin (ibid., p. 286) eliminates "the dualism of mental and material, external and internal processes." A synthesizing solution would be Garrison's (2001) response to Engeström and Miettinen's (1999) exploration of Dewey's interpretation of dual relations between internalization and externalization of objects/objectives.

Garrison (ibid., p. 288) says "objects never lose their event quality" implying man's work on material objects and people supply positive dialectic *resistance* rather than negative opposing *constraints*. So the ideal object of work is nothing like denial of the surrounding circumstances, it is rather an active search for agreement between the partners, paradoxically a search for commitment to fight each other.

The quoted conceptions in Kaptelinin and Nardi (2006, p. 143) contribute to dichotomization between individual agency and structured organization. Other quotes suggest another way of synthesizing "object of activity" by means of ICT. Leontev's (1978) psychological and Engeström's (1999) organizational views on the driving forces of human development supply a formidable unifying example. The *form* of activity is for Leontev individual and collective but for Engeström collective. The *object owners* are for Leontev the individual but for Engeström they are communities. *Salient related phenomena* are for Leontev motivation and need. For Engeström they are material production and transforming routines.

From a US perspective on activity theory Wertsch's (1998) offers a synthesis to the implied 'dispute' between Leontev's and Engeström's approaches. He does so by deploying the concept "mediated action". When an agent acts with culturally developed tools like ICT hard- and software, a creative dynamics is set in motion. Wertsch's (ibid.) model inspires the researcher to go beyond superficial (social) analysis, i.e. comparing, abstracting and generalizing the individual agent. Provided the researcher has got an intention to develop theory in mind, he can understand the forces that shape human action. For the agent-author the object of activity is to compose textual contents that enhance the analytic potential of activity theory.

Interacting with technology

The traditional power structure in a teaching and learning environment is a hierarchical structure with the teacher residing on top. By acting accordingly, teachers enable for new patterns of interactions, communications and relations to appear. Contemporary discursive practices enabled by technology are democratic means and medium at the same time. So, ICT practices complement the teacher's job by facilitating for new experiences, relations and interaction to surface. The technology also imposes restrictions on construction of meaning, relation building and decision making in "social spaces". Hirst and Vadeboncoeur (2006, p. 206) say such social spaces are "most easily defined by conversation, speech and intention." As long as the discoursed spaces cover a participatory and collective approach to schooling, any ICT arrangement offers transformation of the students' objectives, relations and identities. But equally important is that organized social spaces form a short-lived situated practice, a one-off opportunity, i.e. time and place are here and now but only momentarily present. Gieryn (2000, p. 471) suggests that a conservative hierarchical classroom context "stabilizes and gives durability to social structural categories, differences and hierarchies; arranges patterns of face-to-face interaction that constitute network formation and collective action; ["Place"] embodies and secures otherwise intangible cultural norms, identities, memories." Of course there are other kinds of virtual and real life meeting spaces situated in time and place, still materializing as one-off events.

For any social space Nardi (1996, p. 70) asks "How can we confront the blooming, buzzing confusion that is 'context' and still produce generalizable results?" She (ibid, p. 70) eventually justifies her question, saying "It is especially difficult to isolate and emphasize critical properties of artifacts (software) and situations (groups) in studies that consider a full context." Here focus is on the use of ICT in situated group interaction, specifically on an emerging activity which either inspires or alternatively puts off teachers from committing themselves to a shared object, a learning object, an objective

or an “objectified motive” (Christiansen, 1996). Even though activities may overlap and objects be contradictory, Rueda, Gallegos and Moll (2000, p. 71) notes that by deploying a boundary crossing object (Rogoff, 2003) like a hard- and software supported oral session characterized as medium plus activity, analysis of mediation between the participants is an opportunity, because “The sociocultural perspective focuses on features of the basic social organization and the underlying assumptions of a given social context, and considers the effects these might have on students’ *participation and competence* as well as how the individual transforms the context.” Tuomi-Gröhn, Engeström and Young (2003), plus Walker and Nocon (2007, p. 180) argue that ICT designed material and psychological transformation makes it necessary to define an ability in the teacher to elicit higher mental functions by “boundary-crossing” objects between people and media.

[They] understand and negotiate the meanings, through the use of material and symbolic artifacts and understand and negotiate the meanings, through engagement with others, of the practices of a group and of the roles of individuals therein. (p. 180)

In outlining co-configuration of work and contextual learning processes for boundary crossing objects related to ICT, Engeström (2007, p. 33) refers to Keller and Keller (1996, p. 103) who say “tools may well be used in multiple ways even within a given constellation.” However, there is little variability or flexibility in ICT applications, online games excluded (Hansson, 2008). Most companies market their products as an integrated toolkit. The contexts accompanying the software may vary considerably, depending on the participants’ motivation, skills, group dynamics or other. So the actual configuration of ICT artifacts is a unique context in and by itself, a fact which enables for several ways of mediating between objects, processes, texts and people. The limited (constraining rather than restricting) design in many ICT interfaces safeguards *multi-mediation*, a term Bødker and Andersen (2005) introduced (compare *double stimulation* in Portes et al. 1997). However, the major contribution in Engeström (2007, p. 34) and Bødker and Andersen (2005) as in the way they supply a framework for separating mediating processes for collaborative co-construction of meaning, going from technological tool usage to producing pre-empted results and ultimately for purposes of teaching and learning on how to co-construct a shared learning object. For any ICT context, flexibility with the specifics of the context is a prerequisite.

If we take “transformative learning” (Engeström, 2007, p. 36) to encompass a struggle between a social science discourse related to co-configuration work for protecting self consciousness/self-management (SC/SM) and another discourse also related to co-configuration work but for safeguarding professional thinking (PT), there is unity between available texts, applications and procedures, the given concepts, models or procedures suffice because there is a group process of co-configuration (of a learning object) going on during successful verbal sessions. The teachers’ need/motive pushes for transformations between the students’ varying levels of abstract thinking. Also, and contrary to Engeström’s (ibid, p. 36) suggestion, the teachers find a dialectic relation of resistance rather than constraints between design and implementation. Finally, Engeström’s (ibid.) argument that the individual and the collective accompanied by the present and the future “seemed to merge” (ibid, p.36) will not apply as pre-designed software solutions operate from different ways of thinking, suggesting saying and writing combines with spontaneous/reflected and self-conscious/professional transformative thinking. On the other hand, Engeström’s (2007, p. 38) account of transformative learning by co-construction does apply because (a) transformative thinking radically broadens the use of the shared objects. Learning by experiencing (b) puts the participants into imagined, simulated or real situations that require commitment in actions with material objects and artifacts that follow the logic of an anticipated or designed future model of the activity. Finally,

(c) horizontal and dialogical learning creates knowledge and transforms the quality of an activity, by crossing psychological boundaries between activity systems. Statement (c) is true for reasons of group dynamics between peers. Statement (d) is adequate because teachers foresee classroom applications in a new role as facilitators. Statement (e) is appropriate because teachers bring their experience to similar computer room situations where teamwork is necessary. However, further specification of the object of work – in this case learning – is necessary.

In designing and operating ICT user interfaces Beaudouin-Lafon (2000) separate between *domain objects* materializing during object construction and *interaction* facilitated by object instantiation. The domain object is the overall objective which turns a variety of behaviors into an interesting and rewarding exchange of ideas, decision-making and learning session. The instrumentality of the interaction is the actual components which transform the teachers' actions into subtle commands for the domain object. Bødker (1991) suggests a comprehensive approach to understanding how user-technology interfaces should be designed and enacted. One aspect relates to how (i) the user operates the keyboards. Another aspect relates to (ii) the logical structure of interaction with the interface. The third aspect relates to (iii) how verbal objects "inside the computer" relate to oral objects in the open. Any way we choose, there is a need for the technology to be transparent for the user. Bødker (ibid) refers to interactions where the user focuses on the contents of his work while the 'invisible' mediating artifact looms in the background.

In line with early human computer interaction (HCI) research on computer-mediated affordances, Torenvliet (2003) adds to the transparency of the concept by suggesting that a good design should provide visual, oral and tacit clues, powerful enough to guide the user on how to execute operations. Several ICT solutions offer a pre-packaged "interaction design" defined by Winograd (1996) as a space for human communication and action. For educational purposes ICT supposedly transform the users way of thinking, reflecting and learning – if a competent 'cultural broker' (Van Oers, 1998) support activities – and turning the users into technologically empowered and socially contextualized agents. The facilitator's leadership, communication and social skills decide the efficiency of the technology. Roth (2004, p. 2) argues that activity theory is becoming increasingly effective in studies of interaction, communication and education, particularly regarding "the dialectical nature of production and the inner conflicts of human activity." It is however, hard to model, observe and analyze such dynamic contradictions other than by referring to the intricate relationships between subject/object plus theory/practice as given by for example Kurt Lewin, who allegedly said there is nothing as useful for practice as a good theory and also in a similar way productive practices prove to be theoretically rewarding.

Implications of applications

There are methodologically relevant implications of an activity theoretical approach to understanding human computer interaction as a means for inventing designs for teaching and learning. For one kind of focus Nardi (1996, p. 95) suggests research should analyze what people consider as their main objective during man-machine-interaction. For example, is it a realistic objective for research to focus on broad patterns of activity rather than collectively shared tasks and/or fragmented episodes? Some argue it is necessary to understand interactive processes from the individual users' point of view. But any methodology for exploring how people interact and make sense out of computer-mediated sessions needs specifying. Research must establish a point in time in the development of a digital medium when a first instantiation of the phenomenon under study, i.e. community feeling or curricular achievement, appeared and acquired its characteristics. Research must identify the main contradictions during each phase of development. Finally, research must

trace the development of an emerging social system – the necessary and optimal result of participants' ability to solve naturally appearing contradictions.

Young people on social media are aware of the rules of conduct for having meaningful exchanges by means of contact-making, turn-taking, sequencing, time management, systems maintenance, pausing and so forth. Digital inhabitants also know how to navigate and operate in multiple digital contexts because they learn about web-based speech acts, irony, banter and similar forms of communication. It is a valid objective for research to uncover if the actual contents of an individual I-argument, the genius, uniqueness or creativity of an entry or functional we-relations, perceptions and expectations trigger productive responses and enables communities to develop in an environment of shared learning by co-construction of a learning object. Furthermore, it matters if we attach social qualities to an individual agent by reputation, strategy, previous contact, familiarity, antagonism or persistence. Researchers need to inspire colleagues to produce cognitive, psychological or material results. However, it could well be that the challenge of decoding individual behavior by input-process-outcome-feedback merely enables for analysis of the social system. In-depth analysis of elusive learning objects requires a different set of concepts, new models, another approach or complementary theory.

The practical implications of running an Internet project on teaching and learning imply, in the very least, a typology of primary, secondary and tertiary artifacts. Wartofsky's (1979) typology may be applied for demonstrating ICT applications as a means for creating cognitions related to basic curricula and syllabi and to fostering ethical behavior related to dialogue, empathy and therapy (Hansson et al. 2010). Primary artifacts are the equipment. Secondary artifacts are the functioning of the equipment (plus working routines surrounding it). They are deployed for transmitting the skills that people demonstrate in sharing information. Tertiary artifacts transcend the practical processes and realities of a studied phenomenon. The described design creates possibilities for analysis of future-oriented activities. With little discrimination, however, Bødker (1991) and Wartofsky (1979) take onboard a similar perspective on mediating artifacts, covering transparency, affordance and creativity plus – interestingly enough – agency (Kaptelinin and Nardi, 2006). Due to such references, we may narrow down the objective of research on I-agency vs. we-systems thinking. More specifically, we can differentiate between mediation, usage, agency and mental processes. In studying transparency in objects, affordance by objects and creativity in people, we can concentrate on analyses of usage and avoid agency-focused HCI interactions or systemic focused ANT extremes. Such a solution needs further specification and Engeström's (1987) tripartite trajectory for exploring dialogical relations between participants engaged in (i) co-construction, (ii) object construction and (iii) expansive learning offers a valid alternative.

Due to the fact that mediated and mediating interactions cover the interlocutors' goals they are hard to define from the inside for the subjects' motivation as well as from outside behavior for the analyst. During *construction of a learning object*, the subjects pay attention to the task at hand in a self-conscious/self-managing (SC/SM) way. During *instantiation of a learning object* the subjects devote their attention to organization of arguments, statements and questions. Eventually they apply higher order professional thinking (PT) about prospects, applications or audiences. It seems equally reasonable to assume that during instantiation of a learning object the subjects apply "discursive mediation" as a verbal process helping them share and improve their beliefs, values and intentions. For certain, this process is closed for direct observation. On the other hand, the researcher may interpret instantiation of a learning object during the ongoing and expanding discourse. Finally, discoursing between the subjects is the mediating means for weak SC/SM- and strong PT-interlocutors. Several influences, foci and cognitions influence the interlocutors' discourse by means of I-individual and

we-collective object internalization and externalization directed towards learning about a specific theme, constructing a learning object by sticking to the theme and instantiating it by creative *and* structured expansion.

The first one in a number of consecutive steps of such a process is an intuitive and ritual-like process mediated by tradition and culture; the second step is a self-conscious (SC/SM) process relating to group dynamics and social relations; the third step builds on need and motive in the individual interlocutor emerging as professional thinking (PT). If ICT mediated learning were supported by “individual agency” alone the outcome would remain at a self-conscious (SC/SM) level. But if learning were supported by a functional “social system” the outcome would be professional thinking (PT).

Implications of Vygotsky’s (1998) most renowned quotation are rarely acknowledged regarding agency on material and people versus social construction of meaning among people. The quote demonstrates an expansive context for providing a general law on human functioning, thinking, learning and knowledge.

Every function in the cultural development of the child appears on the stage twice, in two forms – at first as social, then as psychological; at first as a form of cooperation between people, as a group, an *intermental* category, then as a means of individual behavior, as an *intramental* category. (p. 169)

When Vygotsky (1997, p. 106) framed the “general genetic law of cultural development” he defined discernible stages of human becoming as given in *New Psychology*. Vygotsky’s (ibid., p. 165) categorization builds on historical aspects of developmental psychology like time, context and history. Basic levels are (i) unconscious reflexes and (ii) consciousness of objects. Relevant levels of analysis in adult behavior cover (iii) self-consciousness and self-mastery (SC/SM) versus (iv) scientific/professional thinking (PT). Items (iii) and (iv) form the key principles for analyzing social activities (Pedler, Burgoyne and Brook, 2005, p. 10). For a low level of (iii) self-consciousness (SC/SM) applies that action is a basis for learning; personal development is the result of reflection on action; discourses are directed towards problems without any right answers rather than towards puzzles which require expert knowledge. For a high level (iv) of professional teacher thinking (PT) there is a need for shared work between peers who challenge each other by posing questions that do not entail a correct answer.

Context of justification

In order to clarify the operational difference, i.e. the effect on individuals in a community of practice between agency defined by individual input during shared sessions and systems thinking defined by how individuals react to their peers’ input, there is a need to draw further for a theoretical frame. Main concepts cover *history, contexts, experiences of time* and *activity*. Data must cover different points of time in a trajectory going from spontaneous socializing (SM/SC) to professional thinking (PT).

Any form of verbal activity - as opposed to insulated singular tool mediated activity - operates as a means for achieving the goal of a particular activity. However in the lucky here-and-now cases, i.e. when individual participants rather than anonymous “social systems” interact effectively, ambitions and fulfillment go beyond the original goal of the interaction. In the unfortunate cases, the actors fail to reach their goals. One explanation would be an inability in the subjects to both express and take on challenging intentions.

Another contention is that mediation by means of a shared discourse differs from tool mediation, which so far has been the most frequently studied context in general activity theory. First of all, this fact has had negative consequences for how we conceive of a trajectory of object construction, object instantiation (= co-construction) and object transformation (= discoursing). Second, very few researchers have focused on contextualized, verbal activities from a perspective of how the learning object and/or the agents develop. Third, is the question whether we should understand discoursing as a decisive context or as a means for defining/obtaining an emerging objective. The answer is tentatively that interaction between participants defines transactions between the subjects rather than operations aiming at transformation of material substances, commodities or other. For most cases, the teacher's behavior, language and rhetoric are automatic rather than deliberately planned manifestations. Rather than relying on an expected structure of interlocutor input, process and feedback quality the subjects interpret the mediating situation as well as their verbal utterances. They realize that individual and shared behavior influence the outcome of learning/design of an evolving learning object. This outcome is contrary to an archetypical understanding of linear teaching and learning plus curricular achievement.

In malfunctioning groups of interlocutors the discourse comes true as a purely linguistic activity, basically for construing intelligible utterances, but without signaling expansive intention, meaning or other. In the failing cases, the compositional structure of interlocutor input is more important than the participating subjects' need, motive or objective to expand a learning object.

Concluding remarks

In contemplation the options how to decide on collective versus individual rationality for explaining human behavior, it is a wise choice to act from a perspective of systems thinking. Neither an individual subject nor a collective of subjects alone influence the potential for learning from interactions aiming at co-construction of a shared learning object. It is rather the singular individual(s) within the group who control collective development of higher mental functions for the members of the group.

It is easy to see why a certain behavior is rational for the I-individual, e.g. to voluntarily supply verbal input during we-group sessions. One kind of input comes naturally as self-enhancement and another kind is more difficult to perform as professional thinking about education, curricula, information, design etc. Many contexts merely inspire provision and exchange of data. However, should the participating members of a medium stop at providing data, little dynamics, motivation or creativity would see the light of day. So why do some individuals find it rational take on the extra "burden" of supplying personal input when all they really need to do is retell distancing pieces of information. It remains a mystery by what inter- or intrapersonal means some subjects manage to "balance" their verbal input so that co-construction of a shared learning object becomes rational for a collective of classmates. Successful participants find it collectively rational to listen, moderate and adapt to individual input on a given curricular theme. Less successful participants post their verbal input at a level which is rational from an individual perspective alone, i.e. they repeat distancing data by referring to anonymous Self rather than to their inherent desire to develop professional thinking by social construction, social competence or empathy and rhetoric combined.

Summary

One inspiration for this study of relevant influences on general activity theory emerges from Kaptelinin and Nardi's (2006, p. 235) closure that research should "theorize transformations between individual and collective levels." For

activity theory, the individual agent engages in object-oriented activity, deliberately striving to fulfill his needs, motives and objectives. For analyses by systems thinking, on the other hand, the individual supplies sterile data and applies simple rules according to a pre-set blueprint. Thus far everything is clear. Outlining the mechanisms for how SC/SM input transforms the individual's inter-mental world and how the PT entries influence peers' intra-mental world remains a bit of mystery.

I have explained differences between individual and collective input to human activity systems. People intuitively construct transform and instantiate learning objects, regardless if they were instructed to do so or merely supply answers to simple questions. A tripartite division of relevant units of analysis consists of individual, collective and individual in group. Focus is on ICT-mediated mediation between the subjects' intentions. An assumption is that their discourse follows the same "rules" as the rules operating in/on collectively co-constructed learning objects in a physical classroom.

My original objective was to separate between individual and collective influences on human behavior. In researching collectively co-constructed and shared "togetherness" it is foolish to refer to an individual actor's behavior. It is equally foolish to refer to a collective subject involved in an activity. But it is wise to refer to pro-active individuals in responsive groups of peers. Also, mediating ICT tools seem to have a crucial impact on the collective(s) of subjects. Hence, future research needs to study the effect of mediating software for promoting professional thinking in a collective of users.

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