From Learning Environments and Implementation to Activity Systems and Expansive Learning

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Abstract. *The paper argues that the notion of learning environment is not a theoretical concept that can serve as the centerpiece and unit of analysis in research on computer-supported collaborative learning, and that the preoccupation in this research domain with implementation of digital learning environments is a largely misguided consequence of the unquestioned expectation that technology will radically change learning. The paper suggests that these two pervasive weaknesses may be at least partially overcome by examining activity systems as an alternative unit of analysis and by focusing on expansive learning instead of implementation as such. A case study of a Finnish middle school demonstrates that it is important to build the introduction of new technologies on the local realities of actual teachers and students. It is unlikely that the implementation and diffusion of advanced digital learning environments will be successful in a school where the teachers will not allow the students to use computers during recess and the students believe that their teachers will in any case take away the computers the next day. In the school examined in the case study, the building of trust and optimism by means of simple new practices and artifacts was the first step toward a serious collective engagement with the potentials of computers for instruction and learning.*

Keywords: *Learning environment, authenticity, implementation, activity system, expansive learning*

Introduction

In studies of computer-supported collaborative learning and related fields of research, the notion of learning environment has gained a central status. The notion is widely used to indicate that learning is somehow situated or distribut-

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ed within a setting which minimally includes individual learners and digital technologies of some kind. While perhaps useful as a catchword, the notion of learning environment has become a virtual substitute for, if not an impediment to, serious theoretical conceptualizations. I will question the explanatory potential of the construct of learning environment. I will suggest that research may benefit from going beyond the notion of learning environment, to such concepts as activity system and network of activity systems.

The implementation of technologically advanced computer-supported learning environments in educational practices is notoriously difficult. As Larry Cuban has repeatedly shown, instructional technologies, in particular computer tools for learning, are oversold and underused (Cuban, 1986, 2001). It is not an exaggeration to say that most of the research and development on digital learning environments leads to prototypes and isolated demonstration-type implementations at best. I will argue that efforts at improving implementation may be largely misguided to begin with. It may be more fruitful to frame the issue in terms of expansive learning in collective activity systems, including schools and other educational institutions.

To concretize these two conceptual shifts (from learning environments to activity systems, and from implementation to expansive learning), I will present a case analysis based on data from the Jakomäki Middle School in Helsinki, Finland, where my research group conducted two cycles of intervention studies, in the school years 1998-99 and 2000-01 (see Engeström, Engeström, & Suntio, 2002a, 2002b).

Learning Environment as a Wishful Ideological Abstraction

The notion of learning environment is usually presented with an attribute. We have *dynamic* learning environments (e.g., Barab & Kirshner, 2001), *innovative* learning environments (e.g., Kirshner, 2005), *powerful* learning environments (e.g., De Corte, Verschaffel, Entwistle, & van Merriënboer, 2003), *collaborative* learning environments (e.g., Beers, Boshuizen, Kirshner, & Gijselaers, 2005), *networked* learning environments (e.g., Wasson, Ludvigsen, & Hoppe, 2003), *smart* learning environments (e.g., Dodds & Fletcher, 2004), *real-life* learning envirnoments (e.g., Järvelä & Volet, 2004), *authentic* learning environments (e.g., Herrington & Oliver, 2000), and many many more.

Common to this plethora of attributes is that they are positive, optimistic, promising, and promotional. They seem to be designed to serve the selling of a wishful image of future learning in which all good qualities of human interaction come true. In this sense, they are thoroughly and blatantly ideological. The ideology behind them is to a large extent the familiar belief in technology as the solution to social problems and human limitations (Feenberg, 1999; Pippin, 1995). In this case, digital information and communication technology is conveniently embedded within the softer notion of learning environment (de Castell, Bryson, & Jenson, 2002).

It seems that the proliferation of positive promotional attributes is a logical counterpart of the scarcity of substantive models and critical theoretical examinations of the notion of learning environment. When researchers miss a workable theory, there is temptation to replace it with positive catchwords.

Learning Environment as a Static and Hierchical Abstraction

The notion of learning environment is commonly taken for granted as a self-explanatory starting point in studies of computer-supported collaborative learning. Attempts at modeling the anatomy of the notion are relatively rare. Many of those attempts are based on the idea of concentric circles that represent multiple embedded layers or scales of a learning environment. A recent model presented by Kirshner serves as a case in point (Figure 1).

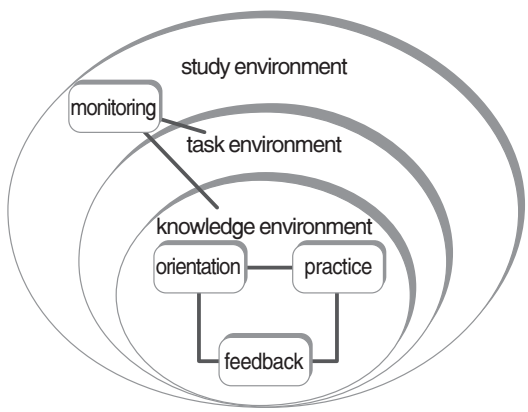

FIGURE 1 The structure of a learning environment according to Kirshner (2005, p. 548)

Models such as this take the context as an envelope or container that surrounds human beings engaged in action. The general structure of concentric circles dates back at least to Bronfenbrenner's (1979) attempt at modeling the nested systemic layers of the ecology of human development. Such models tend to be inherently static and closed, like Russian dolls lying still one within another. It is very difficult to depict and analyze movement, interaction, contradiction, and construction of the context itself with the help of such models. Moreover, concentric circles commonly imply that the smaller circles are hierarchically controlled and constrained by the bigger ones.

The static and hierarchical nature of many models of learning environment corresponds to what Davydov (1990) calls empirical generalization. Learning environment refers to a set of empirically observable phenomena, namely to various uses of digital technologies with the purpose of facilitating learning. The concentric circles actually capture something we often observe in educa-

tional settings where digital technologies are used, namely the encapsulation of the new digitally mediated environments as bubbles within institutions such as schools. Since an empirical generalization does not recognize the origins and dynamic inner contradictions of the phenomena it tries to cover, it becomes an empty shell, a placeholder which can be filled with any number of dimensions or variables that are then used for classifying further items that seem to fall into the general category in question. This is in fact one way the notion of learning environments has been used. Thus, de Kock, Sleegers and Voeten (2004) produced a classification scheme with no less than 18 types of learning environments.

The Dilemma of Authenticity

One of the wishful attributes attached to learning environments is 'authentic.' A recent paper by Gulikers, Bastiaens and Martens (2005) illustrates the dilemma of authenticity and, more generally, the limitations of the notion of learning environment.

According to Gulikers and her co-authors (2005, p. 509), an authentic learning environment "provides a context that reflects the way knowledge and skills will be used in real life."

> This includes a physical or virtual environment that resembles the real world with real-world complexity and limitations, and provides options and possibilities that are also present in real life. (Gulikers, Bastiaens, & Martens, 2005, pp. 509-510)

Reference to 'real life' implies that there is something that is not real, that is, artificial. But what in this world is not artificial, made or modified by humans? There is no such pristine domain of untouched nature.

Or perhaps 'real life' refers to something that is not selected, bounded and controlled by teachers, curricula and instructional materials? But being subjected to instruction, supervision, domination and manipulation is by no means unique to schools and educational institutions. Instruction in the broad sense is a pervasive feature of all walks of life. Paradoxically, it may also be the necessary precondition of learning (Sutter, 2001).

It seems practically impossible to define what is 'non-authentic' or 'not real'. Would school be non-authentic or non-real, as compared to work? Anyone familiar with the regimes of assembly line work, for example, would recognize the absurdity of such a claim. Would objects, events and symbols represented on a computer screen be non-authentic, as compared to objects, symbols and events seen in the street? This might seem plausible until one realizes that the objects, events and symbols in the street are to a large extent staged, purposefully prepared to influence us. Examples of such staging range from the make-up, clothing and cosmetic surgeries displayed by passers-by to the logos and

advertisements painted on cars and plastered on buildings.

Gulikers and her co-authors are not bothered by these problems. They simply characterize an authentic learning environment as "a realistic simulation of the real world" (Gulikers, Bastiaens, & Martens, 2005, p. 510). Their empirical study is a comparison of the effects of two learning environments, an 'authentic' and a 'non-authentic' one, offering basically the same contents.

> Buiten Dienst (Dutch for 'Out of Service') is an ... authentic learning environment that makes use of a lot of multimedia features to improve the realistic nature of the simulation. The student is placed in the role of a junior advisor of a consultancy agency who is given the authentic task to write a report about the causes for the high sick-rate in a bus company and what can be done about it. (Gulikers, Bastiaens, & Martens, 2005, p. 513)

According to the authors, an 'authentic' context was created by simulating a consultancy agency in a virtual way with the help of numerous multimedia features combining visual, aural, and written information. These features included virtual employees who answer questions aurally and a secretary who can assist with administrative issues. Students could talk to the virtual employees, observe a virtual bus driver in his job, and read articles from an archive. They received coaching from a virtual senior advisor.

The 'non-authentic' condition was also an electronic learning environment, but without the multimedia features. All the information was provided in written form only, there was less context information, and there was no virtual senior advisor or secretary. In other words, the practical criterion for authenticity in the study was the presence of multimedia features—voices and video images.

The students' reports were evaluated to measure the learning outcomes. The results showed that students in the 'non-authentic' condition used more content statements in their reports and more words in their reports than students in the 'authentic' condition. In a multiple-choice test, the students in the 'non-authentic' condition also showed a higher level of acquired factual knowledge, but the difference was not statistically significant. Students in the 'authentic' condition did not feel more motivated than students in the 'non-authentic' condition.

In sum, contrary to the researchers' expectations, the 'authentic' learning environment did not lead to better learning outcomes. If anything, the outcomes were worse than those achieved in the 'non-authentic' learning environment. The authors conclude that all the irrelevant information and multimedia features probably distracted students in the 'authentic' learning environment and thus deteriorated their performance.

It seems clear that authenticity, at least in the sense it is used by Gulikers, Bastiaens and Martens as well as many other investigators of learning environments, is a vague and superficial attribute that can hardly be useful in building

a theoretical foundation for computer-supported collaborative learning.

Circular Design of Learning Environment Studies

More importantly, the dilemma of authenticity demonstrates a foundational problem inherent in the notion of learning environment. True to the spirit of the concentric circles, research on learning environments typically begins with the building of a learning environment, a relatively closed task domain dependent on or embedded in digital technology. This task domain and technology are designed and implemented in isolation from (a) the institutional logic of the activity of the school or other organization in which they are located and (b) the logics of the life and study activities of the learners.

However, the researchers expect that the bubble they have constructed is somehow so powerful that it will have significant effects of the quality of learning and motivation. When this does not happen, or the results are less impressive than expected, the typical conclusion is: We need improvements in the learning environment and more studies based on the same basic design. This underlying circular design of many learning environment studies is schematically depicted in Figure 2.

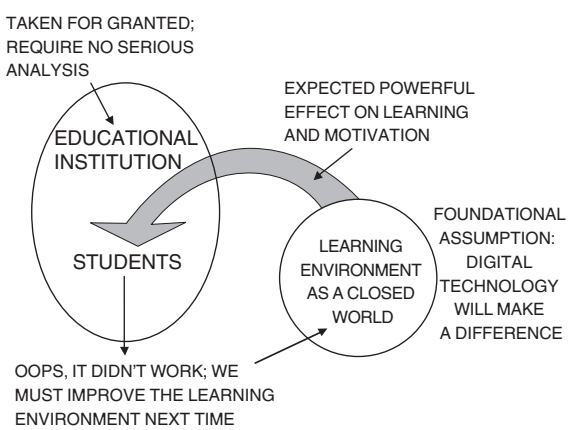

FIGURE 2 The circular design common in learning environment studies

The logic of this design is based on the unquestioned assumption that learning environments based on digital technologies will inevitably make a difference in the quality of learning and motivation. The circular logic makes this kind of research a virtual *perpetuum mobile*—setbacks and meager results only prove that more of the same is needed. This resembles what Argyris and Schön (1978) called 'single loop learning' in organizational settings.

Activity System as Alternative

Michael Cole (1996, p. 135) points out that there is an alternative way of thinking about context, rooted in the Latin term, *contexere,* which means 'to weave together'. In this view, the context is constructed by fibers or threads of action which become intertwined. The fibers themselves are discontinuous, but when you twist them together, they form a rope — a collective activity — which is continuous and durable far beyond the mechanical sum of the separate threads. This is essentially the view of cultural-historical activity theory: human activity makes its own context which is in constant movement, historically and interactionally. For this view to become analytically useful, one needs to identify the general anatomy, or inner structure, of a collective activity system, as well as some dynamics of its movement.

In the cultural-historical tradition, Vygotsky's initial unit of analysis was mediated action (Vygotsky, 1978; see also Zinchenko, 1985, Wertsch, 1985). It is a triangular unity of subject, object, and mediating means (tools and signs). The crucial insight of this unit is the discovery of the dialectic between object and mediating artifact.

Much of the literature on computer-supported work and learning misses or blurs this dialectic, often taking the computer or the program as the object in and for itself and thus creating an idealized self-sufficient system, a closed world (Engeström & Escalante, 1996, Hasu & Engeström, 2000, see also Edwards, 1997).

Leont'ev (1978, 1981) took a decisive step forward in the conceptualization of context when he introduced division of labor into the basic unit of analysis. This enabled him to distinguish between relatively short-lived, goal-oriented actions on the one hand and durable, object-oriented collective activity systems on the other hand. A collective activity can only be carried out by dividing the labor among the members of a community, that is, by assigning different actions to different participants. This requires rules that regulate and sanction exchange and interaction among the participants. The cultural meaning and personal sense of an individual action can only be deciphered by seeing it in the context of the activity it realizes. What emerges is a model of activity as a dynamic mediational system (Figure 3).

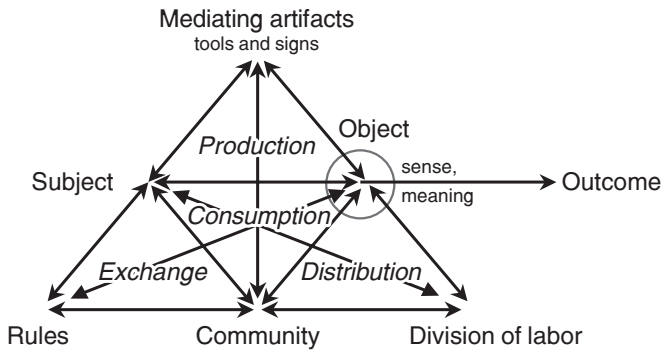

FIGURE 3 Activity as a mediational system (Engeström, 1987, p. 178)

It is the object that makes the dynamic activity a durable system in the first place. An activity system is built around its object. But activities are open systems that depend on one another, forming various kinds of networks and partnerships around partially shared objects. Thus, in today's interconnected world, it is often useful to take two interdependent activity systems as the minimal unit of analysis (Engeström, 2001).

For example, the object of the school-going activity of students is not the same as the object of the teaching activity of the teachers. Both may be dealing with the same curricular contents, textbooks and computer programs, but the motive and meaning attached to them are very different. For the students, the object is a contradictory unity of diplomas and grades (exchange value) and potentially useful knowledge about the world (use value). For the teachers, the object seems to be a contradictory unity of students as containers to be controlled and filled with curricular knowledge, one the one hand, but also students interacting with and transforming the world, on the other hand (the contradiction of control, see McNeil, 1999). The construction of a shared object and a common motive between activity systems with such colliding perspectives is a challenge, never completely achieved and never completely impossible.

The model depicted in Figure 3 can of course be misused as a static representation or categorization device. The model is not a substitute for the theory of activity. It is a conceptual tool to be used by researchers, interventionists and practitioners in the analysis and design of activities. In concrete studies, the model itself needs to be tested and filled with historically specific contents.

From Implementation to Expansive Learning

The problem with technologies is that we would like them to be universal, useful in a wide variety of settings. This tends to blind the technology-driven researcher to the historical and cultural specificity of the particular activity systems in which the technology is supposed to be used. Implementation then

typically becomes a problem. Teachers and other workplace practitioners are seldom as enthusiastic as the researcher expects, and all kinds of resistance arise when new learning environments are to be implemented in everyday use. The traditional stance toward this is a variation of the circle depicted in Figure 2: improvements in the learning environment are made to overcome the resistance, but the taken-for-granted activity systems of the users are not seriously re-examined. While there is a tradition of critical implementation studies in social sciences (e.g., Pressman & Wildavsky, 1984), within the CSCL field only quite recently some authors have begun to question this stance and offer alternative perspectives on implementation (e.g., Keller, 2005).

If one takes the activity systems of the users (for example, teachers and students) as the starting point, implementation no more appears as a task of implanting an alien bubble in an unknown territory. Instead, the issue is reframed as one of transformation. Activity systems are never in perfect equilibrium. They are riddled with inner contradictions that can only be resolved by transforming the activity systems.

There are different transformations, from destructive and regressive to expansive. In expansive transformations, the community learns to widen its object and possibilities for action by re-designing its own activity. This includes remediating the activity with new tools and signs. Digital technologies may play a prominent part among such new mediating artifacts.

Expansive learning proceeds by means of learning actions. An ideal-typical cycle of seven expansive learning actions is schematically depicted in Figure 4

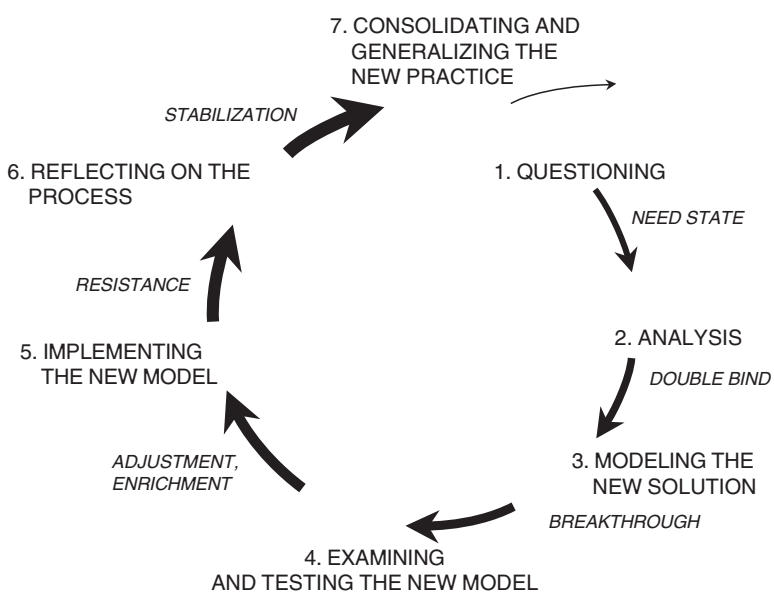

FIGURE 4 The ideal-typical cycle of expansive learning (Engeström, 2001, p. 152)

(for a more detailed treatment of learning actions, see Engeström, 1999b). Each action is associated with particular socio-cognitive processes and states, represented in the figure with smaller text. Notice that implementation appears in the expansive learning cycle as a particular action, after the construction and testing of a new model of the activity.

In the circular design depicted in Figure 2, the foundational assumption is that digital technology will make a difference for learning. The closed circularity comes from this unquestioned assumption: if no significant improvement is found, then the technology must still be inadequate and needs to be fixed or better implemented. In the expansive cycle, the foundational assumption is that the activity system of the learners has the potential to face its contradictions and resolve them in a way that radically expands its object and realm of possible actions. Failures call for critical re-examination of the initial analysis, of the model designed, and of the process itself (for an example of such re-examinations, see Engeström, 1999a).

Bringing in Computers: Expansive Learning in the Jakomäki Middle School

In the school years 1998/99 and 2000/01, we conducted two cycles of longitudinal interventions aimed at triggering expansive learning among the teachers of the Jakomäki Middle School in Helsinki, Finland. The school is located in a socio-economically disadvantaged neighborhood. Some 30% of the students came from recent immigrant and refugee families.

The inner contradictions of the work of Jakomäki teachers appeared in latent forms, as dilemmas *within* components of the activity system, not yet as aggravated tensions *between* components causing constant manifest troubles or

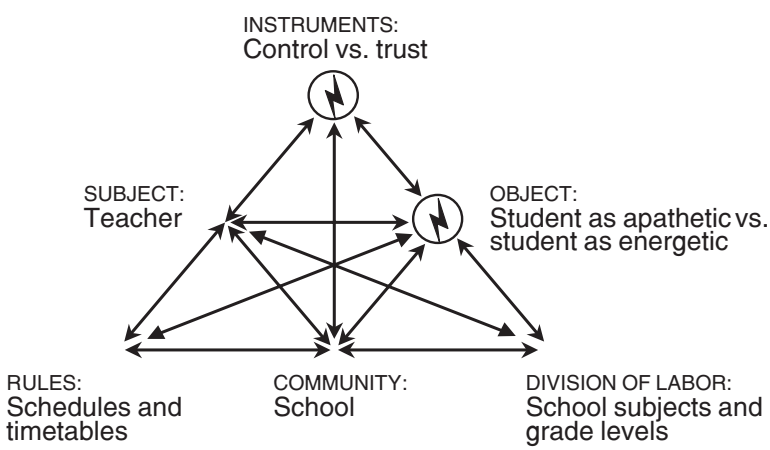

FIGURE 5 Inner contradictions of the teachers' activity system at Jakomäki Middle School (Engeström, Engeström, & Suntio, 2002a, p. 216)

'double bind' situations in everyday practice. The two lightning-shaped arrows in Figure 5 represent the latent contradictions we found salient in the teachers' activity system. The first one (within the object) was manifested in the teachers' repeated talk about students as apathetic—and in occasional utterances where they would contradict their very assessment. The second latent contradiction (within the instruments) was manifested in the teachers' repeated talk about the need to control the students' conduct—and in occasional statements suggesting that the students should be trusted (Engeström, Engeström, & Suntio, 2002a).

In the first intervention cycle, we found that the teachers cherished a stubborn collective myth of their students as apathetic beings who could not be trusted. In spite of this paralyzing myth and the 'underdeveloped' state of the inner contradictions of their activity system, the teachers went on and created potentially expansive and quite durable changes in their work practices. More importantly, the way the teachers talked about their students changed significantly during the year, from predominantly negative talk to predominantly positive talk. Interestingly enough, while positive talk increased quite dramatically, negative talk did not disappear or even decrease in absolute terms. We called this phenomenon 'expansion by enrichment' (Engeström, Engeström, & Suntio, 2002a, p. 220).

One of the several strands of concrete redesign of school work within the first cycle of intervention was focused on computers. As we conducted our initial ethnography in the school, we noticed that the students spent their recesses sitting on the floors of the school corridors (Figure 6).

FIGURE 6 Students spending their recess sitting on the floor of the school corridor

This seemed somewhat bizarre to us, so we asked the students why they did this. The predictable answer was: "Because there is nothing else to do."

EXCERPT 1

Researcher:	What would you like to do? If you had…
Student 1:	They could put computers there…
Researcher:	Where? Would it be somewhere there in the aula…?
Student 1:	Anywhere.
Student 2:	You really think it would stay there for long? I think it would be moved into our classroom the next day.
Researcher:	But you would like to have a computer available during recesses?
Student 2:	Yes.

In the intervention session, we showed video clips depicting students sitting on the floor, and a clip with the exchange of excerpt 1. This 'mirror' material served as stimulus for triggering questioning and analysis (learning actions 1 and 2 in Figure 4). The teachers had an intense discussion in which they repeatedly concluded that computers would be immediately destroyed by the students if left unguarded in the corridors (Figure 7). Toward the end of the discussion, a young teacher who had recently transfered from another middle school presented a different point of view.

EXCERPT 2

Teacher 1:	In my old school, and I have to say that the students there were not any nicer than here, there were computer terminals in the corridors.
Researcher:	Were they used?
Teacher 1:	They were used, constantly. Old terminals were put into use.

FIGURE 7 Teachers discuss the possibility of putting computers into the school corridors

This teacher's input prompted us to contact the school she referred to and ask the computer teacher of that school to make a videotape of their corridor computers and send it to us, to be viewed and discussed in the next intervention session. The computer teacher did as we asked. He explained on the video quite thoroughly that the computers have not been vandalized and have become a permanent feature in the school. This prompted another intense discussion in which the contradictions of the activity system became quite manifest (learning action 2 in Figure 4).

EXCERPT 3

Teacher 2: In principle, that would be a fine idea. There are sixteen machines in our computer classroom, and when we've been there from four to six in the evening, I don't get out of there before seven o'clock. And most often almost all the machines are occupied. So there is crowding there, too.

Researcher: That does not quite fit the image of apathy. There is some sort of a contradiction here.

Teacher 2: What is really strange here is that when I teach them here in the daytime, nobody wants to do anything, "I don't want to bother, I cannot do anything." But when they come here in the evening voluntarily, then everything works and everything is fine. Yet the same faces are there. There is a huge contradiction here.

Here we also witnessed discursive actions that began, albeit hesitatingly, to sketch the new model which would offer students access to computers in the corridors during the recess (learning action 3 in Figure 4).

EXCERPT 4

Teacher 3: By all means, this system would be worth trying out. But one problem we have always had in our school is vandalism. We cannot eliminate it even if the students have passwords and such. We cannot know who has cut the wire or who has stolen the mouse. So we need to be prepared, so that we won't put the most expensive machines out there at the outset...

The concretization of the idea was left to a sub-group of teachers who focused on the revitalization of the school as a physical work environment for both students and teachers. When this group presented its ideas several weeks later in an intervention session, similar hesitations were expressed again. It was as if the teachers were willing to play with the idea, but only with great caution and many reservations. Utterances such as excerpt 5 may be interpreted as a peculiar form of the fourth learning action in Figure 4. Multiple 'buts' were typical to such turns of talk.

EXCERPT 5

Teacher 2: I don't think it is impossible. *But* we must ask students first. And we must also begin to put pressure on the city school board, so that we get these systems in appropriate shape. *But* it cannot be *impossible*.

By the end of the spring semester, the idea of putting computers into the corridors had not materialized and we assumed that it would die quietly during the summer holiday. When we returned to the school in the fall to follow up on the implementation of the new practices the teachers had designed, we were surprised to find a set of comfortable sofas in the aula of the school, as well as benches and computers in the corridors, all heavily used by the students (Figure 8).

FIGURE 8 Computers in the Corridor of the School

The teachers had taken actions of implementation (learning action 5 in Figure 4). These actions were pushed into fruition from the side, by a simultaneous campaign of the city's youth workers who invited youngsters to join in collective efforts to make their physical environments more pleasant. In the Jakomäki school, students were, among other things, offered a possibility to paint interior school walls with new bright colors. The introduction of the computers, initially taken up in our intervention sessions, merged into this concerted effort to improve the physical environment.

The Jakomäki Middle School case teaches us that expansive learning is not linear and cannot be fully controlled by the interventionists. In Jakomäki, the teachers' reluctance and hesitation made the new model (computers for students to use during recesses) weak and its implementation improbable. In other words, it seemed that the inner contradictions of the activity system were not yet aggravated enough to call for committed design and implementation

efforts on the part of the teachers. However, an activity system is an open systems and its lateral interplay with other activity systems (in this case, with the city's youth workers) makes possible surprising empowerments and surges of agency. This indicates that it is useful to extend the unit of analysis to encompass interactions between neighboring activity systems that seem likely to offer potentials for expansion and new forms of agency (Engeström, 2005).

Conclusion

In this paper, I have argued (a) that the notion of learning environment is not a theoretical concept that can serve as the centerpiece and unit of analysis in CSCL research, and (b)that the preoccupation with implementation of digital learning environments is a largely misguided consequence of the unquestioned expectation that technology will radically change learning. I have suggested that these two pervasive weaknesses may be at least partially overcome by examining activity systems as an alternative unit of analysis and by focusing on expansive learning instead of implementation as such.

The case of Jakomäki Middle School is not meant to deny the potential value of advanced digital technologies as tools for education and learning. The case simply demonstrates that it is important to start from the ground, from the local realities of actual teachers and students. It is indeed unlikely that the implementation and diffusion of some advanced digital learning environment will be very successful in a school where the teachers will not allow the students to use computers during recess and the students are sure that their teachers will in any case take away the computers the next day. In Jakomäki, the building of trust and optimism by means of simple new practices and artifacts was the first step toward a serious collective engagement with the potentials of computers for instruction and learning. What followed is another story.

References

Argyris, C., & Schön, D. A. (1978). *Organizational learning: A theory of action perspective.* Reading: Addison-Wesley.

Barab, S. A., & Kirshner, D. (2001). Guest editors' introduction: Rethinking methodology in the learning sciences. *The Journal of the Learning Sciences, 10*, 5-15.

Beers, P. J., Boshuizen, H. P. A., Kirshner, P. A., & Gijselaers, W. H. (2005). Computer support for knowledge construction in collaborative learning environments. *Computers in Human Behavior, 21*, 623-643.

Bronfenbrenner, U. (1979). *The ecology of human development.* Cambridge, MA: Harvard University Press.

de Castell, S., Bryson, M., & Jenson, J. (2002). Object lessons: Towards an educational theory of technology. *First Monday,* 7(1).

Cole, M. (1996). *Cultural psychology: A once and future discipline.* Cambridge, MA: Harvard University Press.

Cuban, L. (1986). *Teachers and machines: The classroom use of technology since 1920.* New York: Teachers College Press.

Cuban, L. (2001). *Oversold and underused: Computers in the classroom.* Cambridge, MA: Harvard University Press.

De Corte, E., Verschaffel, L., Entwistle, N., & van Merriënboer, J. (Eds.) (2003). *Powerful learning environments: Unravelling basic components and dimensions.* Amsterdam: Pergamon.

Dodds, P., & Fletcher, J. D. (2004). Opportunities for new 'smart' learning environments enabled by next-generation web capabilities. *Journal of Educational Multimedia and Hypermedia, 13*, 391-404.

Edwards, P. N. (1997). *The closed world: Computers and the politics of discourse in cold war America.* Cambridge, MA: The MIT Press.

Engeström, Y. (1999a). Expansive visibilization of work: An activity-theoretical perspective. *Computer Supported Cooperative Work, 8*, 63-93.

Engeström, Y. (1999b). Innovative learning in work teams: Analyzing cycles of knowledge creation in practice. In Y. Engeström, R. Miettinen, & R-L. Punamäki (Eds.), *Perspectives on activity theory.* Cambridge: Cambridge University Press.

Engeström, Y. (2001). Expansive learning at work: Toward an activity theoretical reconceptualization. *Journal of Education and Work, 14*, 133-156.

Engeström, Y. (2005). Knotworking to create collaborative intentionality capital in fluid organizational fields. In M. M. Beyerlein, S. T. Beyerlein, & F. A. Kennedy (Eds.), *Collaborative capital: Creating intangible value.* Amsterdam: Elsevier.

Engeström, Y., Engeström, R., & Suntio, A. (2002a). Can a school community learn to master its own future? An activity-theoretical study of expansive learning among middle school teachers. In G. Wells, & G. Claxton (Eds.), *Learning for life in the 21st century: Sociocultural perspectives on the future of education.* London: Blackwell.

Engeström, Y., Engeström, R., & Suntio, A. (2002b). From paralyzing myths to expansive action: Building computer-supported knowledge work into the curriculum from below. In G. Stahl (Ed.), *Computer support for collaborative learning: Foundations for a CSCL community.* Hillsdale: Lawrence Erlbaum.

Engeström, Y., & Escalante, V. (1996). Mundane tool or object of affection? The rise and fall of the Postal Buddy. In B. A. Nardi (Ed.), *Context and consciousness: Activity theory and human-computer interaction.* Cambridge, MA: The MIT Press.

Feenberg, A. (1999). *Questioning technology.* New York: Routledge.

Gulikers, J. T. M., Bastiaens, T. J., & Martens, R. L. (2005). The surplus value of an authentic learning environment. *Computers in Human Behavior, 21*, 509-521.

Hasu, M., & Engeström, Y. (2000). Measurement in action: An activity-theoretical perspective on producer-user interaction. *International Journal of Human-Computer Studies, 53*, 61-89.

Herrington, J., & Oliver, R. (2000). An instructional design framework for authentic learning environments. *Educational Technology, Research and Development, 48*(3), 23-48.

Järvelä, S., & Volet, S. (2004). Motivation in real-life, dynamic, and interactive learning environments: Stretching constructs and methodologies. *European Psychologist, 9*, 193-197.

Keller, C. (2005). Virtual learning environments: Three implementation perspectives. *Learning, Media & Technology, 30*, 299-311.

Kirshner, P. A. (2005). Learning in innovative learning environments. *Computers in Human Behavior, 21*, 547-554.

de Kock, A., Sleegers, P., & Voeten, M. J. M. (2004). New learning and the classification of learning environments in secondary education. *Review of Educational Research, 74*, 141-170.

Leont'ev, A. N. (1978). *Activity, consciousness, and personality.* Englewood Cliffs: Prentice-Hall.

Leont'ev, A. N. (1981). *Problems of the development of the mind.* Moscow: Progress.

McNeil, L. M. (1999). *Contradictions of control: School structure and school knowledge.* New York: Routledge.

Pippin, R. B. (1995). On the notion of technology as ideology. In A. Feenberg, & A. Hannay (Eds.), *Technology and the politics of knowledge.* Bloomington: Indiana University Press.

Pressman, J. L., & Wildavsky, A. (1984). *Implementation.* 3rd edition. Berkeley: University of California Press.

Sutter, B. (2001). *Instruction at heart: Activity-theoretical studies of learning and development in coronary clinical work.* Karlskrona: Blekinge Institute of Technology.

Vygotsky, L. S. (1978). *Mind in society: The development of higher psychological processes.* Cambridge: Harvard University Press.

Wasson, B., Ludvigsen, S., & Hoppe, U. (eds.) (2003). *Designing for change in networked learning environments.* Dordrecht: Kluwer.

Wertsch, J. V. (1985). *Vygotsky and the social formation of mind.* Cambridge, MA: Harvard University Press.

Zinchenko, V. P. (1985). Vygotsky's ideas about units for the analysis of mind. In J. V. Wertsch (Ed.), *Culture, communication, and cognition: Vygotskian perspectives.* Cambridge: Cambridge University Press.