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# *NON SCOLAE SED VITAE DISCIMUS:* TOWARD OVERCOMING THE ENCAPSULATION OF SCHOOL LEARNING

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## Abstract

The separation of school learning from experience and cognition outside the school is illustrated with the help of a study of students' misconceptions of the phases of the moon. Three new approaches to overcome the encapsulation of school learning are discussed: Davydov's theory of ascending from the abstract to the concrete in learning and instruction, Lave and Wenger's theory of legitimate peripheral participation, and finally Engeström's theory of learning by expanding. Davydov's theory suggests that the encapsulation may be overcome by teaching students theoretical and dialectical thinking, embodied in "kernel concepts" of the given curricular subject, seen as powerful cognitive tools that transcend the boundaries of school learning. Lave and Wenger's theory suggests that the encapsulation may be overcome by engaging students in genuine communities of practice either outside school or transplanted into the school. Finally, the theory of expansive learning suggests that the object of school learning should be radically widened, to include the context of criticism, the context of discovery, and the context of application of the given contents. The institutional boundaries of school will be transcended by creating networks of learning from below.

## Introduction

In her 1987 American Educational Research Association Presidential Address, Lauren Resnick took up the issue of discontinuity between learning in school and cognition outside school.

> "The process of schooling seems to encourage the idea that the 'game of school' is to learn symbolic rules of various kinds, that there is not supposed to be much continuity between what one knows outside school and what one learns in school. There is growing evidence, then, that not only may schooling not contribute in a direct and obvious way to performance outside school, but also that knowledge acquired outside school is not always used to support in-school learning. Schooling is coming to look increasingly isolated from the rest of what we do." (Resnick, 1987, p. 15)

Brown, Collins, and Duguid (1989) subsequently initiated a discussion in *Educational Researcher* on new approaches aimed at overcoming this encapsulation of school learning. These authors suggested an educational strategy centered around the notions of

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"situated learning" and "cognitive apprenticeship" (see also Collins, Brown, & Newman, 1989). Their approach evoked critical commentaries (Palincsar, 1989; Wineburg, 1989), as well as presentations of related approaches like the "anchored instruction" of Bransford and his collaborators (The Cognition and Technology Group at Vanderbilt, 1990). Others, notably Gardner (1990), pursued the analysis elsewhere.

In this paper, I will continue and expand this discussion. I will analyze three contemporary approaches, each attempting to break the encapsulation of school learning in a different way. The first of these approaches is the instructional theory of "ascending from the abstract to the concrete", developed in the Soviet Union over a period of three decades by the research group led by V. V. Davydov. The second approach is that of "legitimate peripheral participation", recently formulated by Jean Lave and Etienne Wenger. The third approach, "learning by expanding", has been developed in my own research groups in Finland and in the United States.

While these three approaches are strikingly different, they also share some key ideas. The most important of such shared ideas is that of *joint activity* or *practice* as the unit of analysis. All three approaches draw in varying degrees upon the concept of activity developed by the cultural–historical school of psychology (Leont'ev, 1978; Wertsch, 1981). And all three put a heavy emphasis on the role of mediating artifacts in human cognition and learning.

My discussion of the three approaches is necessarily biased in that I myself work within the framework of the third approach. However, I also find myself in substantial agreement with several basic propositions of the two other approaches. What follows is not a comparison aimed at ranking the approaches according to their merits and weaknesses. Instead, I will try to do two things. On the one hand, I want to present the approaches as alternative and mutually complementary theories, each adding a unique and useful angle to our understanding of the issues at hand. On the other hand, I want to weave together some of their ideas in order to identify promising vistas for future research and theorizing.

In my analysis, I will use an empirical example drawn from my own research on the problems of school learning. The example is that of students' misconceptions of the phases of the moon. I will examine how each of the three approaches might propose to overcome the encapsulation of school learning in this particular content area.

## Finding Out About Things in Everyday Life

Imagine that you became interested in a simple natural phenomenon: Why does the moon change its visible shape? Why does it regularly become totally invisible and then partially visible again? In other words, what causes the phases of the moon?

If you took the action of finding out an explanation, you would probably turn to other people for help as well as to books containing graphic models that purport to explain the phenomenon. You might also observe the phenomenon more or less systematically, perhaps using a notepad and a pen to record and analyze your observations. This action of "finding out about it" is schematically depicted in Figure 1. Such an action may be embedded in a more enduring activity, such as astronomic hobby or child rearing, for

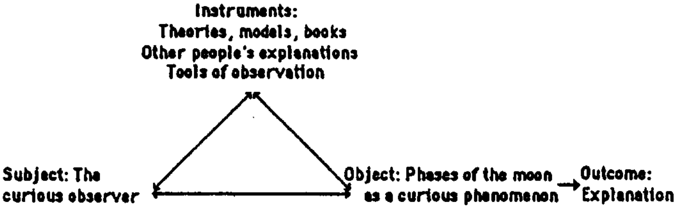


Figure 1. The everyday action of finding out about the phases of the moon.

example. But the action may arguably also emerge out of sheer curiosity, as a discrete short-term entity without an anchoring in a broader, more enduring activity system.

The structure depicted in Figure 1 is not necessarily an "ideal" model for learning. It takes discrete, situationally occurring problems, phenomena and procedures as "natural" units of learning. The need for and possibility of understanding broader contexts that may produce and explain the discrete problems are not addressed by this kind of everyday learning. Resnick (1987, pp. 15–16) points out that such everyday learning tends to result in "highly situated skills" which — especially if routinized in repeated practice — are difficult to modify, abandon and replace with novel procedures when the task and the context change. As we will soon see, the model of everyday learning is in this respect surprisingly similar to the model of traditional school learning.

## The Separation of School Learning From The Rest of Experience: The Phases of The Moon Misconceived

Several years ago, I published a paper titled "Students' Conceptions and Textbook Presentations of the Movement of the Moon: A Study in the Manufacture of Misconceptions" (Engeström, 1984). The study was based on the following simple question presented to a number of Finnish school students between ages 14 and 17.

> "What is the reason for the fact that at times only a part of the moon is visible or it is not visible at all, even though the sky is cloudless? In other words: What causes the different phases of the moon? Clarify your answer with the help of a drawing."

The most common answer among both the younger and the older students was that the moon is regularly covered by the shadow of the earth, which causes the new moon.

> "The earth casts its own shadow in front of the moon. That's why the moon is not always wholly visible, sometimes not visible at all." (Girl, grade 11)

> "If the moon is not visible, it is behind the earth. If the moon is wholly visible, then it is directly in front of the earth and the sun shines straight on it." (Girl, grade 11)

> "The shadow of the earth is cast over the moon in different sizes as the moon revolves around the earth." (Boy, grade 11)

> "The earth comes in between the sun and the moon. Thus, the shadow of the earth is reflected upon the moon. That is why only a part of the moon can be seen." (Boy, grade 8)

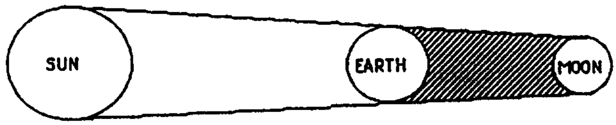


Figure 2. Depiction of the dominant misconception produced by students.

Great many subjects illustrated this explanation with drawings. The standard drawing looked as shown in Figure 2.

This, in fact, is a fairly accurate description of a relatively uncommon event, the lunar eclipse — and a completely incorrect explanation to the regular phenomenon of new moon.

As the next step of that research, I presented the same question to another group of Finnish secondary school students, aged 17. Again, 50% of the subjects gave the answer "moon is covered by the shadow of the earth". This time, after the completion of the answer, each student was given the following further question.

> "Once in awhile lunar eclipses take place, too. Why do they take place? Clarify your answer with the help of a drawing."

While answering this second question, the students were allowed to keep the sheets containing their answers to the first question.

Obviously the same mechanism of "the shadow of the earth" cannot account for both the lunar eclipse and the new moon. By forcing the students to reflect upon the lunar eclipse, I wanted to check the effect of a conceptual conflict on their conceptions. Interestingly enough, almost all (81%) of the students who had produced the dominant misconception as their answer to the first question produced the same answer again to the second question.

Now what do these findings tell us? I got the initial idea for my study from a well known German educator Martin Wagenschein, who reported an informal inquiry he had conducted among the visitors of an observatory, using essentially the same question. The visitors were asked how it came about that the shape of the moon changes from full moon to half moon, to quarter moon, and to new moon.

> "The result at the end was very interesting. About 80% of those who were asked knew no correct answer, regardless from which social stratum they came. (. . .) I can add to this finding from my own experience: among university students, about every fourth gives the same quick but absurd answer: it is the shadow of our earth that makes the moon time and time again into a crescent.
>
> The lack of knowledge as such is not bewildering. Honest ignorance about difficult things belongs to education. But here the truth is easy to see; and it is even easier to notice that it would be impossible for the shadow of the earth to cover the moon. For the crescent is never far away from the sun in the sky and never opposite to it (which would have to be the case, if our shadow were to be cast over it). The modern man has here often outright mislearned what the natural science could have taught him: to observe the thing. What is even more problematic, instead of knowing what he could see, if he had learned to look, he has empty sentences readily at hand. And these he has taken from another much more uncommon phenomenon which he also has left unobserved and not understood, namely the lunar eclipse. He has mislearned through so called learning". (Wagenschein, 1977, pp. 42–43)

Wagenschein calls this phenomenon "synthetic stupidity". He contends that the moon and the sun of the classroom have for the students nothing to do with the moon and the sun they can daily see in the sky.

> "Thus, in astronomy, it is especially easy to realize how natural scientific knowledge can, quite unnecessarily, become alienated from reality and fragmented. It then fragments us, too. What fragments has nothing to do with education." (Wagenschein, 1977, p. 45)

Wagenschein does not go into the concrete mechanisms behind the "synthetic stupidity". However, his basic argument is provocative. It contains an account of the nature of the students' misconceptions fundamentally different from that given by most researchers in the field of "everyday conceptions" or "naive conceptions". The misconceptions are not indications of immature thinking. They are culturally produced artifacts which often persist regardless of maturation.

The phases of the moon and the lunar and solar eclipse are taught in grade 4 in the Finnish comprehensive school. I analyzed the textbooks officially approved for use in this subject and grade level in the comprehensive school. The differences between the books were minimal. All textbooks build their explanation of the phases of the moon on a basic diagram, an example is shown in Figure 3.

The diagram looks perfectly reasonable. It is clear and graphical. One wonders what can cause the students' difficulties in assimilating this simple model. An analysis of the textbooks and adjunct materials reveals two rather evident problems concerning the treatment of the phases of the moon.

First, the relationship between the phases of the moon (especially the new moon) and the lunar eclipse is not problematized in any of the textbooks. The lunar eclipse is presented with the help of an equally simple and graphic diagram as the one used in connection with the phases of the moon. But it is presented as the next topic, neatly separated from the discussion of the phases of the moon. This is a prime example of the "discrete tasks" Levy (1976) named as the basic form of compartmentalization. The connection is never worked out. Obviously there is no automatic guarantee that such connections are realized in everyday learning outside school either.

Secondly, the basic diagram of the phases of the moon is not constructed and applied by the students as an instrument for the analysis of reality. It is given as such, in a finished form. The adjunct materials contain tasks that demand the identification, naming and

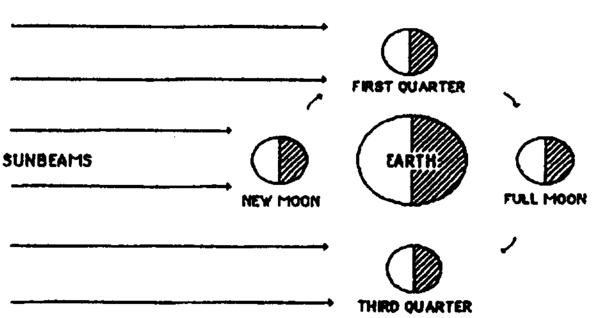


Figure 3. The standard textbook diagram of the phases of the moon.

classification of the different phases or shapes of the moon. The dynamic model behind the diagram is never constructed and tested by students.

These two problems are rather evident. They do not tell much about the specific cognitive mechanisms involved in the confusion between the new moon and the lunar eclipse. One step further in the analysis of the textbooks provides some indications of the nature of these mechanisms.

As you look at the basic diagram presented above, you may notice how conveniently close the earth and the moon are to each other and how little difference there is in their sizes. This is a fundamental, recurrent feature in all the textbooks and students' drawings I analyzed. In reality, if the sun were symbolized with a ball with a radius of little over 50 cm, the earth would be symbolized with a ball with a radius of just a little over 0.5 cm and located 150 m from the sun. The moon would then be symbolized with a ball whose radius would be 1.75 mm and which would be located nearly 40 cm from the earth. These distances and sizes are almost unthinkable on the basis of the neat textbook diagrams. Something very essential is destroyed with the loss of distances and sizes. The students cannot very easily grasp how small the likelihood is that the shadow of the earth hits exactly on the moon and makes it invisible. Actually this destruction of sizes and distances may lead children to give artificially "naive" answers to researchers who are using such distorted pictures as "props" (see e.g., Nussbaum, 1979, p. 86).

Even more fundamental than the loss of distances is the loss of the third dimension. The basic diagram is unable to show the depth of the space. In fact, the textbooks analyzed do not even mention it in this connection. As the image of space becomes flat and two-dimensional, it is nearly impossible to avoid the notion that the shadow of the earth must indeed necessarily hit the moon every time the moon revolves around the earth — especially since the moon in the diagram seems to be quite close to the earth.

The world of texts is very much a world of two-dimensional linearity. The relatively closed world of textbooks is certainly no exception. Traditionally, teachers have used simple mechanical telluriums to illustrate three-dimensionally the relations between the sun, the earth and the moon. Nowadays, these devices are commonly considered old-fashioned and clumsy, and the colorful books and workbooks are considered sufficient for purposes of illustration.

Expanding on the model used in Figure 1, we may now summarize the findings of this study as an example of the encapsulation of school learning (Figure 4).

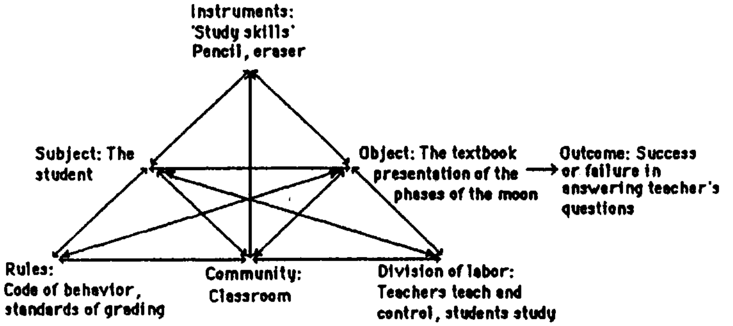


Figure 4. A traditional school learning model for studying the phases of the moon.

Figure 4 differs from Figure 1 in important ways. It depicts the school text as the object of the activity instead of being an instrument for understanding the world. When the text becomes the object, the instrumental resources of the activity are impoverished — students are left "on their own devices". Resnick (1987, p. 13) points out that in school, the greatest premium is placed upon "pure thought" activities — "what individuals can do without the external support of books and notes, calculators, or other complex instruments." This instrumental impoverishment produces what Resnick (1987, p. 18) calls "the symbol-detached-from-referent thinking."

School learning is obviously a collective and relatively enduring activity system. Therefore, I have added the components of community, division of labor, and rules to the rather self-explanatory triad of Figure 1. Community refers to those who share the same object of activity. In traditional school learning, it is typically a classroom. Division of labor refers to the division of functions and tasks among the members of the community. In traditional school learning, the main division is between the teacher and the students while there is little division of labor between students. Rules refer to the norms and standards that regulate the activity. In traditional school learning, the most important rules are those that sanction behavior and regulate grading.

## The Formation of Theoretical Concepts by Ascending from the Abstract to the Concrete in Instruction

Among the various modern approaches to instruction and learning, V. V. Davydov's theory stands out both because of an exceptionally elaborate epistemological and conceptual framework (see Davydov, 1977, 1988a, 1988b) and because of the large body of experimental research accumulated on the basis of the theory both in the Soviet Union and elsewhere (see e.g., Aidarova, 1982; Davydov & Lompscher, 1982; Hedegaard, Hakkarainen, & Engeström, 1984; Lompscher *et al.*, 1989; Markova, 1979; Steffe, 1975). In the present context, I will only briefly summarize some general tenets of the theory and then focus on its implications for the problem of encapsulation of school learning.

The core of Davydov's theory is the method of ascending from the abstract to the concrete. This is a general epistemological approach, used by Karl Marx in *Capital* to derive a comprehensive, concrete theory of capitalism from the abstract and simple "germ cell" or "kernel" of commodity as a contradictory unity of use value and exchange value (see Ilyenkov, 1982). Davydov (1977, 1988b) demonstrates how this method can be turned into a powerful strategy of learning and teaching.

> "When moving toward the mastery of any academic subject, schoolchildren, with the teacher's help, analyze the content of the curricular material and identify the primary general relationship in it, at the same time making the discovery that this relationship is manifest in many other particular relationships found in the given material. By registering in some referential form the primary general relationship that has been identified, schoolchildren thereby construct a substantive abstraction of the subject under study. Continuing their analysis of the curricular material, they disclose the rule-governed link between this primary relationship and its diverse manifestations, and thereby obtain a substantive generalization of the subject under study.
>
> Then children utilize substantive abstraction and generalization consistently to deduce (again with the teacher's help) other, more particular abstractions and to unite them in an integral (concrete) academic subject. When schoolchildren begin to make use of the primary abstraction and the

primary generalization as a way of deducing and unifying other abstractions, they turn the primary mental formation into a concept that registers the "kernel" of the academic subject. This "kernel" subsequently serves the schoolchildren as a general principle whereby they can orient themselves in the entire multiplicity of factual curricular material which they are to assimilate in conceptual form via an ascent from the abstract to the concrete." (Davydov, 1988b, Part 2, pp. 22–23)

Davydov points out that the strategy of ascending from the abstract to the concrete leads to a new type of theoretical concepts, theoretical thinking, and theoretical consciousness. Theory is here understood not as a set of fixed propositions but as "an instrumentality for the deduction of more particular relationships" from a general underlying relationship (Davydov, 1988b, Part 2, p. 23). Theoretical concepts entail high-level metacognitive functions, such as reflection, analysis and planning.

The strategy of ascending from the abstract to the concrete has two characteristic traits. First, it moves from the general to the particular in that students initially seek out and register the primary general "kernel", then deduce manifold particular features of the subject matter using that 'kernel' as their mainstay. Secondly, this strategy is essentially genetic, aimed at discovering and reproducing the conditions of origination of the concepts to be acquired. It requires that "schoolchildren reproduce the actual process whereby people have created concepts, images, values, and norms (Davydov, 1988b, Part 2, pp. 21–22)."

Davydov distinguishes six learning actions constitutive of learning activity that follows the logic of ascending from the abstract to the concrete.

"(1) transforming the conditions of the task in order to reveal the universal relationship of the object under study;
(2) modeling the identified relationship in an item-specific, graphic, or literal form;
(3) transforming the model of the relationship in order to study its properties in their "pure guise";
(4) constructing a system of particular tasks that are resolved by a general mode;
(5) monitoring the performance of the preceding actions;
(6) evaluating the assimilation of the general mode that results from resolving the given learning task." (Davydov, 1988b, Part 2, p. 30)

In recent years, Davydov's collaborators have paid special attention to mechanisms of group collaboration in learning activity ascending from the abstract to the concrete (see Jantos, 1989; Rubtsov, 1981; Rubtsov & Guzman, 1984–85).

Now what has this approach to offer toward breaking the encapsulation of school learning? In particular, how would it proceed to teach the phases of the moon?

In general terms, Davydov's theory suggests that the encapsulation of school learning is due to an empiricist, descriptive and classificatory bias in traditional teaching and curriculum design. Knowledge acquired in the school is usually of such quality that it fails to become a living instrumentality for making sense of the bewildering multitude of natural and social phenomena encountered by students outside school. In other words, school knowledge becomes and remains *inert* (Whitehead, 1929) because it is not taught genetically, because its "kernels" are never discovered by students, and consequently because students do not get a chance to use those "kernels" to deduce, explain, predict, and master practically concrete phenomena and problems in their environment. Thus, the encapsulation can be broken by organizing a learning process that leads to a type of concept radically different from those produced in prevalent forms of schooling.

In the particular framework of my example, the Davydovian approach would teach the solar system — and the entire conceptual system of astronomy — by first discovering and modeling the simple initial abstraction of astronomy. What that initial abstraction might be is a question to be solved by intensive analysis conducted jointly by subject-matter specialists, psychologists and educators. The movements of specific heavenly bodies, including the curious phases of the moon, would be problematized, observed and explained concretely with the help of the "kernel" formulated on the basis of the initial abstraction. Such experiments involving design and implementation of totally new curricula and teaching materials have produced impressive learning and transfer results in a variety of subject-matter areas during the past three decades (for a partial summary of the Soviet work, see Davydov, 1988b, Chap. 6; for a summary of the work conducted in the GDR, see Lompscher, 1989).

This solution is depicted in Figure 5. Notice that the school text is no more the object of the activity. Instead of a closed text, there is an open 'context of discovery' to be reconstructed through practical actions by the students.

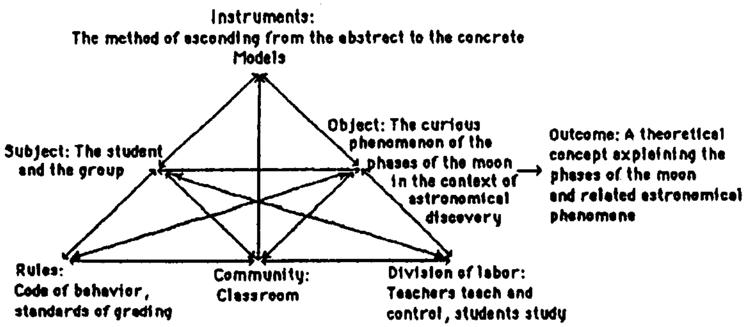


Figure 5. A Davydovian model for acquiring an understanding of the phases of the moon.

While the upper sub-triangle of the model has changed rather dramatically, the bottom part remains curiously similar to the model depicting traditional school learning (see Figure 4). Davydov's theory does not predicate qualitative changes in the rules, community and division of labor existing in traditional school learning.

In summary, Davydov's solution to the encapsulation of school learning is *to push school knowledge out into the world* by making it dynamic and theoretically powerful in facing practical problems. In some sense, this looks like a narrowly cognitive and scientistic strategy. The social basis of school learning doesn't seem to be altered by this strategy, which makes one wonder whether there will be motivation among the students to carry out the strategy.

On the other hand, the strategy differs fundamentally from most cognitivist approaches to instruction in that it is not satisfied with improving the quality of learning texts. By making the practical historical *context of discovery* of theoretical knowledge the object of learning, this approach opens up a whole new dynamic of contents. It does not pretend to eliminate the power of the teacher, but by putting students into dialog with the discoverers of the past, the strategy may well empower the students.

## Legitimate Peripheral Participation and Communities of Practice

Jean Lave and Etienne Wenger are not satisfied with the yield of the Davydovian approach.

> "(. . .) the social character of learning mostly consists of in a small 'aura' of socialness that provides input for the process of internalization viewed as individualistic acquisition of the cultural given. There is no account of the place of learning in the broader context of the structure of the social world." (Lave & Wenger, in press)

Lave and Wenger propose an alternative approach based on the notion of learning as gradually increasing participation in a "community of practice". The authors argue that "social practice is the primary, generative phenomenon, and learning is one of its characteristics" (Lave & Wenger, in press). Thus, learning should be analyzed as an integral part of the social practice in which it is occurring. To change or improve learning, one should reorganize the social practice.

This point of departure leads the authors to an analysis of different forms of apprenticeship — ranging from Mexican Yucatec midwives to American meatcutters and anonymous alcoholics — as examples of legitimate peripheral participation. Lave and Wenger point out that in all their examples there is very little observable teaching but a lot of well-motivated and effective learning. Learning commonly proceeds from less important, simple tasks toward crucial and complex "core" tasks. At the same time, an overall picture of the activity gradually unfolds as the learner moves from one partial task to another.

> "There are strong goals for learning because learners, as peripheral participants, can develop a view of what the whole enterprise is about, and what there is to be learned. Learning itself is an improvised practice: a learning curriculum unfolds in opportunities for engagement in practice." (Lave & Wenger, in press)

Lave and Wenger suggest that learning as participation in communities of practice is particularly effective (a) when participants have broad access to different parts of the activity and eventually proceed to full participation in core tasks, (b) when there is abundant horizontal interaction between participants, mediated especially by stories of problematic situations and their solutions, and (c) when the technologies and structures of the community of practice are transparent, that is, their inner workings can become available for the learner's inspection.

Although Lave and Wenger themselves decline to elaborate on the implications of their approach to school learning, their approach raises important questions. Obviously schooling as a social practice itself should be analyzed from the viewpoint of legitimate peripheral participation. In fact, this has been a preoccupation of many insightful students of the "hidden curriculum" in the past (e.g., Henry, 1963; Holt, 1964). Such analyses show that schooling produces a variety of learning experiences and results which are unintended, if not altogether objectionable, from the viewpoint of the official curricula. The question is, what can the approach formulated by Lave and Wenger offer in terms of an alternative.

The logical solution would be to create good communities of practice within schools. In other words, the social organization of the school should be changed so that it would allow for communities of practical activity demonstrating the three criteria listed above.

Recent papers by Collins, Brown, & Newman (1989) and Schoenfeld (in press) attempt to sketch properties and preconditions of such communities of practice within school.

How would this approach reorganize the teaching of the phases of the moon? To identify a relevant a community of practice, one would simulate what astronomers, or those who apply astronomical knowledge, do in their daily activity. Such practices might involve astronomical observations, calendar making, or similar tasks where the phases of the moon would become a practically relevant question within the framework of a broader activity. Moreover, technologies for making astronomical phenomena transparent — perhaps computer simulations and videodisc applications — would be employed. These tools might provide for high-fidelity virtual worlds, simulated practices of gathering, representing and applying astronomical knowledge. The structure of this solution is depicted in Figure 6.

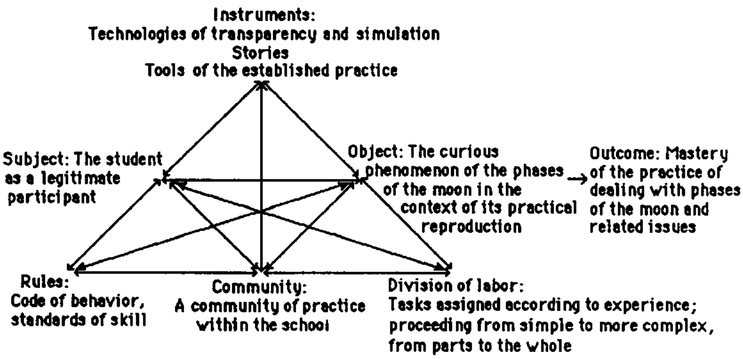


Figure 6. A legitimate peripheral participation model for acquiring an understanding of the phases of the moon.

The object of the activity is now the *context of practical application*, in other words, of meaningful contemporary social use and formation of knowledge about the phenomena to be mastered. This is clearly different from the context of discovery suggested by the Davydovian model. Innovations are not precluded from the context of application, but the genetic origination of the key ideas of the discipline is not systematically sought and replicated.

The viability of this approach seems to be dependent on the successful identification of a meaningful social practice that can be transferred into school and still retain some degree of authenticity. Lave and Wenger admit that they are vague in their analysis of social practices. Their approach could easily be turned into just another theoretical legitimation for building technology-intensive microworlds in schools without serious consideration of the meaning of those worlds in the lives and social circumstances of the participants.

In summary, the legitimate peripheral participation approach seems to propose to solve the problem of encapsulation of school learning by *pushing communities of practice from the outside world into the school.* This transition is not easy, however, as Wineburg (1988, p. 9) pointed out in his commentary.

> "But to survive in the marketplace of ideas, a theory of learning has to be situated in a *theory of schooling*. Otherwise, it may leave its mark on archival journals, but leave the world of classrooms virtually untouched."

## Learning by Expanding

In the conclusion of my original paper on the misconceptions of the phases of the moon, I wrote:

> "If it is true that textbooks create closed and often illusory compartments in the minds of the students, should it not be desirable that the students learn to treat the textbooks as historical artifacts, as attempts to fix and crystallize certain generally accepted conceptions of the epoch? This would imply that (. . .) the students are led to (. . .) analyze and use textbooks as limited sources, often in need of thorough criticism." (Engeström, 1984, p. 61)

This brief passage contains an important seed of the theory of expansive learning. Since school is a historically formed practice, perhaps the initial step toward breaking its encapsulation is that students are invited to look at its contents and procedures critically, in the light of their history. Why not let the students themselves find out how their misconceptions are manufactured in school?

Such a search will lead to questions like "Why is this being taught and studied in the first place?" Gregory Bateson points out that such questions are explosive. They open up a wider context into which the current problematic situation is put. Bateson calls such an expansion of context "level III learning". He notes that "even the attempt at Level III can be dangerous, and some fall by the wayside" (Bateson, 1972, pp. 305–306).

To turn expansive learning, or "level III learning", into a nonpathological course, the learners must first of all have an opportunity to analyze critically and systematically their current activity and its inner contradictions. This I will call *the context of criticism*.

In a school setting, the critical analysis of current practice could well start with a hard look at textbooks and curricula in particular content areas. The "hidden curriculum" of tacit classroom practices could well be analyzed by students, for instance by using videotaped lessons as material. Students could analyze their own test and examination questions and answers, as well as outcomes of their own learning in terms of duration, understanding and transfer. These are substantive metacognitive procedures, quite different from the formal metacognitive skills commonly listed in literature.

But the context of criticism should be extended even further. Students do not come to school as empty vessels. They are exposed to a constant bombardment of information from multiple sources, particularly from mass mediated popular culture. In this sense, they live in a multilayered world of texts in which textbooks are only a visible tip of an iceberg. The relationship between the school knowledge offered by textbooks and the fantasies nurtured by media and artifacts of popular culture are of particular interest in the context of criticism (see Engeström, 1985).

Secondly, the learners must have an opportunity to design and implement in practice a way out, a new model for their activity. This means that the learners work out a new way of doing school work. In other words, students must learn something that is not yet there; they acquire their future activity while creating it (see Engeström, 1987).

This second component also proceeds through particular contents. It seems possible that the three approaches discussed above — Davydov's ascending from the abstract to the concrete, Lave and Wenger's legitimate peripheral participation, and critical analysis of the current practice of learning and instruction — could be employed as complementary modes of inquiry by students and teachers in particular content areas. This would make the *relationships between the context of criticism, the context of discovery, and the context of practical social application* the new, expanded object of learning.

Envision a school where students proceed through (1) a critical analysis of the traditional way of presenting and misconceiving astronomical material, as well as of images and fantasies created in encounters with mass mediated popular culture, (2) a Davydovian process of finding, modeling and using a "kernel" abstraction to make sense of the entire subject matter of astronomy, and (3) an involvement in using and reproducing astronomical concepts in a relevant social practice inside or outside school, whatever that practice might be. These three steps don't necessarily have to be successive. They can also be parallel, even performed by different collaborating groups of students and teachers, providing for multivoiced exchanges.

This idea is in line with the recent emphasis on the multiplicity of "ways of knowing" (Eisner, 1985; Gardner, 1983) and on the distributed, multivoiced nature of human cognition (Cole & Engeström, in press; Wertsch, 1991). Each of the suggested three complementary modes of knowing and learning has distinct cognitive, motivational and social strengths. The context of criticism highlights the powers of resisting, questioning, contradicting, and debating. The context of discovery highlights the powers of experimenting, modeling, symbolizing, and generalizing. The context of application highlights the powers of social relevance and embeddedness of knowledge, community involvement and guided practice. Moving between these contexts provides for intertextuality in the sense discussed by Carpay and Van Oers (1990).

This kind of an expansion in the object implies a qualitative transformation in the entire activity of school learning. Miettinen (1990) characterizes this as formation of networks of learning that transcend the institutional boundaries of the school. He describes an advanced network of learning as follows.

> "It includes educational researchers, researchers of certain fields of science, practitioners, teachers, parents, and pupils. There are several examples of this kind of collaboration. A project called *Art and Built Environment* was carried out in England between 1976 and 1982. In this project, the network consisted of architects, community planners, teachers, and pupils. The idea of the project was to study the surroundings of the school and to give pupils models and instruments to influence their surroundings." (Miettinen, 1990, p. 24)

Moll and Greenberg (1990) provide a recent example of such a network in the making. They are working with parents, teachers and students in a Hispanic community of Tucson, Arizona, looking for new ways of literacy instruction that draw upon knowledge and skills found in local households.

> "We build on the idea that every household is, in a very real sense, an educational setting in which the major function is to transmit knowledge that enhances the survival of its dependents. (. . .) In order to examine the instructional potential of these household activities, we have created an after-school 'lab' within which researchers, teachers, and students meet to experiment with the teaching of literacy. We think of the lab setting, following Vygotsky, as a 'mediating' structure that facilitates strategic connections, multiple paths, between classrooms and households (Moll & Greenberg, 1990, p. 320; for further examples, see Sutter & Grensjö, 1988; Cole, 1990)

Eventually the school institution has to be turned into a collective instrument for teams of students, teachers, and people living in the community. Figure 7 depicts the transition from traditional school learning to expansive learning with the help of vertical arrows placed in the different components of the model.

The crucial difference between Figure 7 and the preceding models is that in expansive learning the context of learning itself is altered. School learning reflectively reorganizes itself as an activity system. This kind of collective and reflective self-organization is becoming a necessity in practically any kind of social practice. Resnick (1987, p. 18) notes that people must become "good *adaptive learners*, so that they can perform effectively when situations are unpredictable and tasks demand change." I would rephrase the idea: Collectives of people must become good expansive learners, so that they can design and implement their own futures as their prevalent practices show symptoms of crisis. The notions of "progressive problem solving" and "working at the edge of one's competence", recently put forward by Bereiter and Scardamalia (in preparation), are in line with the concept of expansive learning.

In summary, expansive learning proposes to break the encapsulation of school learning by expanding the object of learning to include the relationships between traditional school text, the context of discovery and the context of practical application, thus *transforming the activity of school learning itself from within*. This transformation is carried out through particular curriculum contents. It is a long, distributed process, not an once and for all transformation dictated from above.

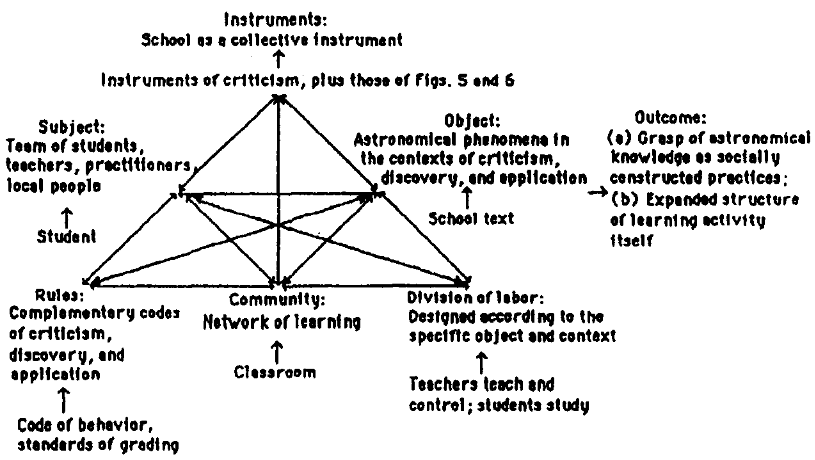


Figure 7. An expansive learning model for acquiring an understanding of the phases of the moon.

How likely is such a scenario in real life? There is one point that makes this approach perhaps more realistic than either the Davydovian approach or the legitimate peripheral participation approach would be alone. The expansive learning approach exploits the actually existing conflicts and dissatisfactions among teachers, students, parents and others involved in or affected by schooling, inviting them to join in a concrete transformation of the current practice. In other words, this approach is not built on benevolent reform from above. It is built on facing the current contradictions and draws strength from their joint analysis.

## Conclusion

The Davydovian solution to the encapsulation of school learning is to create such powerful intellectual tools in instruction that students can take them into the outside world and grasp its complexities with the help of those tools. While there is ample evidence of the relative power of the Davydovian approach in particular areas of subject matter, we know little of its overall effects on the lives of students and on the activity system of the school. It is not clear how one would motivate schools to adopt the demanding instructional strategy of ascending from the abstract to the concrete.

The legitimate peripheral participation approach would break the encapsulation the other way around, by creating genuine communities of practice within schools or perhaps by partially replacing school learning with participation in such communities of practice outside school. It is not known to what extent and under what preconditions such a transformation might be possible and what would be the specific qualities of desirable communities of practice. Again, it is an open question whether schools could be motivated to engage in such a transformation.

The expansive learning approach would break the encapsulation of school learning by a stepwise widening of the object and context of learning. The expanded object of learning consists of the context of criticism, the context of discovery, and the context of application of the specific curricular contents under scrutiny. This kind of expansive transition is itself a process of learning through self-organization from below. The self-organization manifests itself in the creation of networks of learning that transcend the institutional boundaries of the school and turn the school into a collective instrument.

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