The Quality of Cultural Tools and Cognitive Development: Gal'perin's Perspective and Its Implications

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The Quality of Cultural Tools and Cognitive Development: Gal'perin's Perspective and Its Implications[1]

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Key Words

Cognitive development · Cultural tools · Gal'perin · Instruction · Learning · Vygotsky

Abstract

Vygotsky theorized that instruction plays a key part in cognitive development by providing culturally evolved cognitive tools which, once internalized by the child, mediate and advance the child's cognitive functioning. Gal'perin further elaborated this approach arguing that it is the quality (specific character) of cognitive tools (such as concepts, criteria, schemas) acquired by the child that to a large extent defines the specifics of cognitive development. He theoretically explicated and empirically tested an alternative type of instruction which, unlike traditional instruction, directly generated cognitive development by providing cognitive tools of a higher quality (based on theoretical concepts as opposed to empirical concepts). The often overlooked yet important implications of Gal'perinian perspective are: 1) that there is a need for the theory of development to conceptualize and integrate the processes related to learning, and 2) that most existing theories of development capture just one possible version of development – the version that is bound to deficient cognitive tools employed in the currently dominating type of instruction.

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In this article, we argue that one of the most potent ideas in Vygotskian psychology is the idea that the specific character of culturally evolved cognitive tools acquired by the child in the course of instruction defines in large measure the specifics of the child's cognitive development. Accordingly, the analysis of the specific qualities of cognitive tools learned by the child (such as concepts, criteria, measures, schemas, etc.) helps to operationalize the relationship between development and learning.

This idea was implicitly present in the initial Vygotskian framework and has been further elaborated and empirically supported by Russian followers of Vygotsky, most prominently, by Piotr Gal'perin and his colleagues. Our main goal is to trace the elaboration of this idea (and the set of related assumptions) in Gal'perin's work, and to discuss important implications for developmental theory and research that are often overlooked by researchers in this area [cf., Van der Veer & Arievitch, 1994]. In our view, Gal'perin's approach offers an advanced account of cognitive development in relation to learning. Namely, Gal'perin's contribution makes it possible to conceive of development as being contingent on the specifics of instruction, in particular, certain qualities of cognitive tools provided to the child rather than as a process that is internally driven and limited by naturally imposed characteristics of the child's mind.

Following Vygotskian tradition, in this article we mostly discuss instruction as an interactive process. Instruction in this sense is by no means a one-way activity of the adult (i.e., teaching) but it necessarily includes a corresponding activity of the child (i.e., learning). Sometimes, when formal aspects of instruction are less important than the activity of the learner, we refer to a concept of learning.

We first discuss the relevance of the concept of culturally evolved cognitive tools for resolving the question about the relationship between cognitive development and instruction. We point out that, whereas in Western research on learning and development the qualitative aspect of cognitive tools has largely been neglected, it was an important issue for the Russian followers of Vygotsky.

We then focus on Gal'perin's approach in which the role in development of cognitive tools of different quality has been systematically investigated. We show that Gal'perin has greatly extended Vygotsky's arguments about the leading role of instruction in the child's cognitive development by specifying the kind of instruction that can play such a role. Namely, Gal'perin's work elucidated the specific character of cognitive tools and instructional procedures that makes instruction truly developmental (i.e., development-generating). To illustrate this point, we present the main types of instruction described by Gal'perin and then analyze their relationship to cognitive development. Based on this analysis, we discuss some general implications of this approach, in particular, the need to integrate the specifics of instruction into theoretical accounts of cognitive development.

Development and Learning: The Relevance of Culturally Evolved Cognitive Tools

In modern psychology, a vast number of studies on the relationship between development and instruction have been inspired by works of Vygotsky – long after his death – who argued for the central role of instruction in children's cognitive development. This claim distinguishes Vygotsky's position from the views that cognitive development is relatively independent of instruction and that instruction merely follows development and thus should be adapted to the already achieved level of development [e.g., Piaget, 1955]. Research conducted in the Vygotskian tradition develops for the most part his concept of the Zone of Proximal Development (ZPD), focusing on the forms of the child's interaction with adults and peers in broad sociocultural context and in different educational settings [Brown, 1997; Brown & Campione, 1996; Brown & Palincsar, 1989; Bruner, 1990; Cole & Scribner, 1974; Laboratory of Comparative Human Cognition, 1983; Rogoff, 1990; Rogoff, Radziszewska, & Masiello, 1995; Wertsch, 1984; Wood, Bruner & Ross, 1976; and many others, cf. Stetsenko & Arievitch, 1996]. These studies reveal substantial specifics of interaction between the child and adult as well as between children in a collaborative learning activity which lead to development.

Some works draw on Vygotsky's notion of internalization and extend conceptualization and empirical evidence of how the novice develops into a competent performer [e.g., Tharp & Gallimore, 1988; Wertsch, 1979]. A number of innovative teaching programs have developed consistent with this work [e.g., Forman & Cazden, 1995; Palincsar & Brown, 1984]. These theoretical models and teaching programs represent an important step in elaborating the notion of ZPD and generally provide evidence that collaborative learning indeed advances cognitive development, that is, it promotes qualitative change in children's cognitive abilities and performance [for details see, e.g., Brown, 1997; Rogoff, 1990, 1994].

In research stemming from traditions other than Vygotskian, the evidence of the central role of instruction in cognitive development, not just in transmission of specific knowledge and skill, is also growing [e.g., see Ceci, 1991; Perkins & Grotzner, 1997]. For example, a number of recent studies have demonstrated that thinking and intelligence can be taught and learned if appropriate instructional methods are used [e.g., Halpern, 1998; Perkins, 1995; Salomon & Perkins, 1989]. In particular, the findings point to the pivotal role of means involved in distributed cognition [e.g., Cobb, 1998; Salomon, 1993; McTighe & Lyman, 1988], and to the importance of activating the monitoring and reflective function of metacognition [e.g., Marshall, 1995; Scardamalia & Bereiter, 1985], and of other methods of cognitive reorganization.

As a result of all these studies, the 'classic' question as to *whether* instruction has a substantial impact on cognitive development is gradually transforming into the question of *how* this impact occurs [cf., Ceci, 1991; Sternberg, 1997]. However, the exact ways in which instruction participates in development remain to a large extent unclear. For example, by what means learning within the ZPD propels children's development and what mechanisms underlie the child's transition to a qualitatively advanced cognitive functioning still remain open questions.

We suggest that the lack of progress in such questions is largely due to the fact that in most Western studies on learning and development the 'quality' of *what* the child is learning (e.g., how the qualities of acquired concepts reflect the essential characteristics of the studied subject domain) is not viewed as a formative aspect of the child's cognitive development. In other words, *the quality* of historically developed cultural tools provided by the adult and internalized by the child is usually not taken into account in the analyses of development in its relation to instruction [for few notable exceptions, see Engeström, Hakkarainen, & Hedegaard, 1984; Hedegaard, 1990, 1995; Lompscher, 1984]. For example, as mentioned above, recent studies on the ZPD primarily focus on the forms and specifics of shared activity but not on how what is taught to the child affects development [e.g., Lave and Wenger, 1991; Rogoff, 1994; Rogoff et al., 1996].

The concept of scaffolding is another example. Although this concept is often hoped to help operationalize the concept of the ZPD [e.g., Wood et al., 1976], it is only loosely related to the concept of cognitive tools and implies that the quantity or contingency (e.g., moving to less intervention after success and to more intervention after failure) rather than quality of content of the adult's assistance has a decisive role in the child's cognitive progress [Greenfield, 1984; see similar remarks in Tharp & Gallimore, 1988].

To compensate for this, another study addressed the issue of strategies of adult assistance and the resulting qualities of children's cognitive functioning. In this case, the focus was on such means of assisting students' performance as modeling, contingency managing, feedback, questioning, and cognitive structuring [Tharp & Gallimore, 1988]. However, this analysis concerns the character of adult-child interaction itself (with the teacher responsible for structuring the child's activity in a systematic way) but not the character of integral thinking tools (e.g., concepts, models, criteria) within such an interaction. The relevance for cognitive development of what exactly is taught to the students – the kind of concepts – is again not considered.

As for the studies on learning and development conducted outside the Vygotskian tradition, these two processes, for the most part, are still viewed as essentially different and independent of each other, and the question of how the content of learning is related to cognitive development is hardly even raised [for reviews, see Ceci, 1991; Snow, 1986]. The same can be said about didactic-oriented research, where important findings concerning the significant role of new educational content and procedures for the outcomes of learning [e.g., Cobb, 1998; Marshall, 1995] are not translated into new conceptualizations of the nature and mechanisms of developmental processes. In this research, often the role of powerful didactic solutions as a possible driving force of cognitive development is not discussed.

In short, the concrete character of cognitive tools (such as concepts, criteria, schemas, and models) provided to the child for domain-specific problem solving is usually left out in the analysis of learning and development. Based on Gal'perin's ideas and research, we will show below how this poses significant limitations on operationalizing the role of learning in development in terms of qualitative change in individual cognitive functioning.

Importantly, the idea that the quality of acquired cultural tools crucially affects the child's development is present in Vygotsky's original approach. According to Vygotsky, the acquisition of cultural tools, such as language, signs, and concepts, constitutes the main content of the child's mental development. Hence, the focus in many of Vygotsky's works is on the role of instruction, the major 'provider' of those tools. In Vygotsky's view, the quality of instruction is crucial in terms of the effects it produces on development. When instruction addresses the highest possible levels of performance that the child is capable of in active cooperation with the adult, it expands the child's Zone of Proximal Development and leads development [Vygotsky, 1934; 1935; 1981]. According to Vygotsky, instruction exercises such a leading role in the child's cognitive development through its specific content: Instruction provides new, more efficient cultural psychological tools (e.g., concepts) for domain-specific problem solving. The child acquires such tools while using them with adult assistance. These psychological tools then mediate and transform the child's cognition. For example, teaching scientific concepts to the child at school (as opposed to everyday or 'spontaneous' concepts of preschoolers) arms the child with new cognitive tools that enhance his/her abilities for domain-specific problem solving [Vygotsky, 1934; 1978].

Although insightful, these general ideas required further elaboration and experimental analysis. Vygotsky himself did not specify how the particular content of instruction is related to development, and in particular, how specific qualities of the cognitive tools acquired by the child affect development. This became one of the major issues in the Russian branch of post-Vygotskian developmental and instructional psychology [e.g., Davydov, 1972; El'konin & Davydov, 1966; Gal'perin, 1966/1967; Talyzina, 1975; for overviews see Haenen, 1996; Karpov & Haywood, 1998; Kozulin, 1995; Wertsch, 1981].

In our view, within this branch of research the work of Gal'perin and his colleagues provides the most extensive evidence that the quality of cognitive tools and the ways these tools are introduced to the child define the concrete role of instruction in development and the developmental outcomes themselves. Gal'perin's studies also provide a conceptual basis for integrating research on learning and instruction into theories of development. However, many theoretical implications of this approach still have to be spelled out.

In the rest of this article we discuss the significance of Gal'perin's work for understanding the relationship between development and learning. On this basis, we then formulate some general implications for developmental theory and research.

Gal'perin's Analysis of the Role of Instruction in Cognitive Development

Piotr Gal'perin (1902–1988) was a contemporary of Vygotsky, Luria, and Leont'ev and shared with them many basic assumptions of cultural-historical psychology. However, unlike his colleagues, Gal'perin's work has received much less attention in Western psychology. In addition, his work is often inadequately perceived [cf., Van der Veer & Arievitch, 1994]. He is largely referred to as a purely educational psychologist, the author of concrete instructional techniques, although in fact his work is much broader in scope and encompasses original contributions to fundamental problems of developmental psychology.

At the center of Gal'perin's theory is the issue of the origins of mind and the nature of developmental cognitive processes. Gal'perin approached these issues by studying the process of internalization of cultural tools as a specifically human form of the individual's cognitive development [El'konin & Davydov, 1966; Gal'perin, 1966/1967]. In this respect, Gal'perin's theory clearly continues the Vygotskian line of thought. However, Gal'perin went much further in that he operationalized Vygotsky's concepts of cultural tools, mediation, and internalization by scrutinizing the ways in which the specifically human, internal, plane of mental activity is formed [for details see, e.g., Arievitch & Van der Veer, 1995; Haenen, 1996; Van Geert, 1987].

In order to clarify how the individual's actions become internalized, Gal'perin turned to the analysis of the structure and formation of human action. He based his work on the assumption that mental actions can be conceptualized as transformed and abbreviated material actions. He dedicated much of his efforts to exploring the concrete regularities, tools, and stages of transformation of action from its material to mental forms.

It is in these studies that Gal'perin arrived at what became another cornerstone of his approach: the innovative analysis of three types of instruction with different developmental potential. Gal'perin experimentally established the core features of a new, developmental type of instruction (i.e., instruction that generates cognitive development). This was Gal'perin's way of operationalizing Vygotsky's ideas about the leading role of learning in mental development and the mechanisms that are responsible for this role.

In the next sections, we outline the three main types of instruction analyzed by Gal'perin[3] – traditional instruction, systemic-empirical instruction, and systemic-theoretical instruction. We then comment on the relationship of cognitive development to the character of cognitive tools employed in these types of instruction.

Traditional Instruction

The first type of instruction analyzed by Gal'perin can be referred to as 'traditional' instruction (although Gal'perin himself never used this term). The main features of this type of instruction are deficits in children's orientation in the essential characteristics and conditions of the task, and the empirical character of teaching-learning. Gal'perin argued that despite many differences in instructional methods and learning conditions in various circumstances and contexts of education as we presently know it, there is a basic underlying similarity in those methods that shape the developmental outcomes. Gal'perin maintained that the striking similarity of Vygotsky's and Piaget's conclusion (despite all the differences in their views on cognitive development) that children come to be able to form and use genuine concepts only at the age of 10–12 years can be explained not by some inherent regularities of the child's mind and its development. Rather, in Gal'perin's view, the similar developmental trajectory in the child's conceptual development described by both Piaget and Vygotsky can be attributed to the profound similarity of instruction that both scientists indirectly dealt with when studying children's development in preschool and school settings and modelled in their experimental work (Gal'perin, 1985; Gal'perin & El'konin, 1967].

What makes the great many various methods of teaching-learning just different versions of basically the same *type* of instruction? Gal'perin argued that such a unifying feature is that most instructional methods fail to provide the child with all the necessary tools and conditions for correct orientation in the task and therefore, for correct performance. Rather, this type of instruction provides the child with only part of such tools. As a rule, traditional instruction is based on: (a) the teacher's presentation and explanation of the task, (b) the presentation of general rules of problem-solving, (c) the explanation of those rules using a typical example, (d) the learner's memorization of those rules, and finally (e) practice in solving typical problems.

Even when the teacher is doing his/her best, the complete set of tools and conditions (indications, leads, clues, algorithms of action) to orient onseself in the task and to act correctly to solve the problem is most often not provided to the student. Many

[3] We are aware that many important parallels exist between Gal'perin's approach and Davydov's theory of developmental teaching. This is no coincidence, given that Gal'perin was Davydov's mentor during Davydov's university studies and they remained in close contact long after. Many of the basic starting points in Davydov's theory have been influenced by or derived from Gal'perin's work [Davydov, 1988]. Here we cannot undertake a comparative analysis of these two approaches, although we realize that by limiting our article in this way we do not do full justice here to the research of Davydov and his followers.

implicit rules and regularities that an expert 'automatically' takes into account as a basis for action remain hidden to the beginner. Each student has to figure out on his/her own a substantial part of such conditions for acting correctly, while trying (often unsuccessfully) to perform a given task. Large numbers of trials and errors are inevitable in this case, as is a slow, gradual selection of the correct composition of action necessary to handle the task (e.g., to establish the attributes of a concept).

The deficit of tools and conditions for adequate orientation in the task negatively affects the quality of the learner's actions. These actions often remain unstable, poorly generalized, limited to familiar tasks with no or little transfer, and dependent on incidental variations in the instructional situation (e.g., the teacher's individual style). This inevitably results in large inter-individual differences in children's performance. As to developmental outcomes (such as genuine concept formation) in this type of instruction, it is practically impossible to trace their sources and their relation to instruction. As a consequence, for teachers and psychologists, it appears more logical to refer to age-related regularities and inborn inter-individual differences in mental abilities when explaining outcomes of learning rather than to specifics of instruction [Gal'perin, 1976/1989c]. However, as we will discuss below, instability of performance, poor generalization, and insignificant transfer, although very common, are not inherent to all learning, and the reference to innate abilities to account for poor results of traditional instruction in many cases is unnecessary. We will illustrate the main differences between types of instruction analyzed by Gal'perin by describing a comparative study by Pantina [1957] in the section on systemic-theoretical instruction.

The traditional type of instruction still dominates most educational systems. A great many teaching methods in all their diversity belong to the same type of instruction because of the basic underlying similarity – a deficient, incomplete set of necessary conditions for the orientation of action. Although such incompleteness can vary in concrete form and degree, it is always present in the traditional type of instruction. Importantly, this feature of traditional instruction only becomes clear when it is compared to alternative types of instruction built on a sufficient (complete) orientation in the task, which we discuss below.

Systemic-Empirical Instruction

In the second type of instruction, the child is provided with all the necessary conditions (criteria, indications, clues, algorithms of action) to adequately perform the task. These conditions are organized as a comprehensible system in a generalized symbolic form. The child is therefore enabled to use this system in its fullness, from the very beginning, as a new cognitive tool providing an orientation basis to handle certain classes of tasks within a given subject domain. While the child applies this tool to solve a set of tasks and problems, its application (that is, a new cognitive action) undergoes a series of transformations and finally gets internalized thus becoming a part of the child's cognitive functioning [Gal'perin, 1966; 1985].

The general principles of this type of instruction can be summarized as follows: (a) designing a sufficient orientation basis for the child to efficiently solve a given class of problems; (b) ensuring and guiding the child's reflective performance, and (c) guiding transformation of the child's action relevant to the task from its material form into an internalized mental form. In the next section, we will illustrate the specific features of this type of instruction with a comparative study of different types of instruction by Pantina [1957].

Following the above principles, in the 1960s and 1970s Gal'perin and his colleagues carried out experimental work on the systematic formation of many kinds of actions, concepts, and skills. Curriculum areas included the formation of geometrical concepts [Gal'perin & Talyzina, 1957/1961]; concepts in physics [Obukhova, 1968], elementary mathematics [Minskaya, 1966], and history [Semenyuk, 1970]; skills of simultaneous identification of objects [Podol'skij, 1978], of visual problem solving [Arievitch & Nechaev, 1975], systematic thinking [Danilova, 1978], or typewriting [Malov, 1976]; teaching foreign language [Kabanova, 1976], and professional training [Orestov, 1989; Reshetova, 1985], as well as the formation of attention skills in children with serious attention problems [Gal'perin, 1976/1989c; Gal'perin & Kalbyl'nitskaya, 1974; Osipova, 1977]. Scores of experiments have been carried out in laboratories, schools, and at enterprises. Experimental curricula encompass both limited topics, such as teaching methods of geometrical reasoning in secondary school [Butkin, 1968] or skills to perceive three-dimensional figures on the basis of their two-dimensional projections [Lerner, 1980], and long-term programs, such as a four-year elementary school course on mathematical problem solving [Tsatskovskaja, 1978]. Participants have varied from preschool children to young industrial workers. Teaching experiments have been carried out in different cities of Russia and Ukraine. The full list of teaching-learning studies carried out from the 60's through the 70's in the Soviet Union in the vein of Gal'perin's principles exceeds 800 works. For the sake of brevity, we refer the reader to the overview of some of these studies by Haenen [1996].

In these studies, it became clear that many traditional views of what and how young children are able to learn and many requirements as to how to teach young children are not scientifically grounded. Such requirements are usually explained by hypothetical age-related limitations of children's cognitive processes and mental development, but the analysis indicates that they reflect the outcomes of the instructional strategy of the traditional type. A radical change in instructional strategy makes many of those requirements unnecessary.

In particular, the traditional requirement when teaching young children to start from graphic and concrete examples and gradually proceed to the formulation of a general rule is no longer necessary: the basic rule and criteria are present in the orientation tool from the very beginning. Another common requirement – to introduce a subject (or new action or skill) gradually, 'bit by bit' (one fragment after another) also is no longer necessary. On the contrary, the subject needs to be presented in all its 'parts' from the very beginning. For example, in foreign language instruction, different tenses of the English language are usually studied separately, one after another. In experimental instruction, however, those tenses have been successfully presented to children all together in an orienting chart (schema) as a meaningful interrelated system [Gal'perin, 1985]. Similarly, over 200 specific rules of Russian punctuation are usually studied in consecutive order and in isolation of each other. In an experimental curriculum, those rules were all presented in a generalized systematic form at the initial stages of teaching [Talyzina, 1998]. Contrary to what might have been expected on the basis of the traditional perspective on children's cognitive abilities, in both cases the systematic and complete forms of presentation remarkably facilitated the children's orientation in and accelerated high-quality mastery of complex subject domains.

Yet another traditional requirement, to start from simple tasksand then proceed to more difficult ones, also is no longer needed: children were provided with cognitive tools (orientation schemas) which enabled them to perform a task of any difficulty in a given domain. For example, armed with such orientation schemas (with a complete set of rules and criteria), children confidently distinguished between apparently different or between very similar but still different architectural styles [Gal'perin, 1985]. Finally, there is no longer need for rote memorization of basic rules: children mastered these rules – for example, the rules of identification of geometrical forms [Gal'perin & Talyzina, 1961] or the rules of systematic analysis of the problem [Danilova, 1978] – in the course of their application to different tasks with the help of orientation schemas presented in a convenient material form [also see Haenen, 1996].

No less significant was that trials and errors, so typical of traditional instruction, became rare and incidental. The time it took to form a new action, skill, or concept decreased sharply, fluctuations in the quality of performance from one case to another became minimal, and transfer increased. Recently, these results were supported by findings from many studies in instructional design [e.g., Carpay, 1974; Terlouw, 1993].

This type of instruction can be referred to as *systemic-empirical* (although, again, Gal'perin himself never used such a term). It is systemic because all the necessary conditions and criteria for effective performance are presented to the child as an interrelated meaningful system (schema) from the very beginning. But it is empirical because it is based on empirical concepts in which the 'inner logic' of a given subject domain remains to a large extent hidden – in many cases not only to the learners but also to the teachers. This still restricts the student's performance and makes the acquired cognitive tools suitable only for a limited number of specific assignments in a particular domain. We will come back to further clarify this point in the description of the next, systemic-theoretical type of instruction.

Systemic-Theoretical Instruction

The third type of instruction which was analyzed (and in fact discovered) in Gal'perin's work is most revealing with regard to the question of how learning relates to development. This type of instruction can be referred to as *systemic-theoretical instruction*. Its essence is in providing the students with means for theoretical (conceptually based) generalization which allow them to orient themselves in a systemic way in the studied subject.

In systemic-theoretical instruction, students acquire a general method to construct a concrete orientation basis to solve any specific problem in a given subject domain. Such a general method involves a theoretical analysis of objects, phenomena, or events in various subject domains. The main feature of the analysis is that it reveals the 'genesis' and the general structure of objects or phenomena (the basic make-up of things). In such analysis, students learn to distinguish essential characteristics of different objects and phenomena, to form theoretical concepts on this basis, and use them as cognitive tools in further problem solving.

More specifically, such analysis includes (a) discriminating among different properties of the object or phenomenon, (b) establishing the basic unit of analysis of a particular property, and (c) revealing to the child the general rules (common to all objects in the studied area) of how those units are combined into concrete phenomena. Learning in systemic-theoretical instruction always occurs in the form of students' active exploration of the studied subject under the guidance of a teacher. The method makes extensive use of symbolic and graphic models to represent basic relations between different properties of the object and the order of their systematic analysis [Gal'perin, 1985].

While learning the theoretical method of analysis in the course of its active application in problem solving, the students acquire genuinely theoretical concepts that they use as cognitive tools for dealing scientifically with any object or phenomenon in a given domain – even when a subject domain does not at all seem to be 'scientific', as for example, in teaching children to write letters of the Russian alphabet.

In a comparative study by Pantina [1957] on different types of instruction, three groups of 6-year-old children learned to write letters of the Russian alphabet. The first group was taught in the traditional way. The teacher gave the pattern of a letter to the students, explained, and demonstrated how to write the letter. The explanation sounded like this: 'We begin at this point and draw the line downwards until here; then start to curve here to this point; and then turn upwards to approximately this point ...'. There was no mention of the basic segments composing the letter. Students then started practicing in reproducing this letter under the teacher's supervision. The teacher pointed to the child's mistakes and, if necessary, repeated the explanation. When the students were able to copy the letter correctly, the teacher introduced another letter, and so on. Learning in this group went very slowly, with many trials and errors. Even at the end of instruction, children experienced difficulties in reproducing the letter. Their performance was unstable and showed little transfer to other letters or forms of contour [for details, see Haenen, 1996].

In the second group, systemic-empirical instruction was used. The students were given not only a 'specimen' of the final product – the pattern of a letter – but also an additional orientation tool, namely, a model reflecting the structure of a given letter. On this model, students could see all the crucial dots (orientation indices) of the letter's contour. Under the guidance of the teacher, the students learned to copy those indices and reproduce the letter on this basis – in the beginning, with the help of semi-transparent paper to put over a model. Later they learned to use a special set of lines on the paper for copying the indices and reproducing a letter. The whole procedure was repeated then with another letter, and so on. For each new letter the teacher needed to provide anew the necessary set of indices. Learning in this group proceeded more quickly and successfully than in the first group due to sufficient orientation tools provided to students. The student's performance was much more stable and of higher quality. However, there was no easy transfer to other letters or forms of contour. The students' orientation in the task was complete (for writing a given letter) but empirical.

The third group was taught according to the principles of systemic-theoretical instruction. The students mastered the method of theoretical analysis of any contour. The contour was characterized by its model – the system of indices placed in those positions where the line starts, ends, or changes its direction. Thus the students learned how to identify the crucial indices in any letter and to establish the basic analytical units of the contour – the lines with no change in direction. Using this general method, the students could then reproduce the model of any letter on another page and copy the letter itself. The explanation involved the demonstration of only one letter; starting with the second letter, the students themselves (under the teacher's guidance) isolated the indices, constructed the model, and copied the letter. Having mastered the method of constructing concrete orientation tools (sets of indices) for any letter, the students then advanced very quickly and soon could analyze and reproduce the contour visually, without putting dots on the paper. Errors soon became rare. In the end, students easily reproduced any letter of the Russian alphabet. Moreover, there was an unusually wide transfer: Children came to be able to reproduce any contour with high precision – letters of Latin, Arab, and Armenian alphabets, stenographic symbols, blueprints, and unfamiliar pictures. In addition, there was a dramatic improvement in children's problem solving of any problem involving coordination in the plane, and even in their counting – probably as a result of the precise organization of objects in space [Pantina, 1957].

The ideas contained in systemic-theoretical instruction are quite close to those of some recent studies by American psychologists on different types of learning and generalization [e.g., Bassok and Holyoak, 1993; Dettermann, 1993]. These studies discuss the advantage of top-down generalization (transfer) as opposed to bottom-up generalization. In bottom-up learning, students are expected to infer general principles from multiple empirical examples. In contrast, top-down learning is based on the conceptual analysis of the problem and focus on the general principle at the beginning of problem solving. Like Gal'perin, these authors emphasize the advantages of conceptually based learning in terms of breadth and conscious character of generalization and transfer. However, as we will show below, Gal'perin's analysis of systemic-theoretical instruction is more far-reaching with regard to the theoretical nature of concepts and procedures involved in instruction, as well as to its developmental potential.

The principles of systemic-theoretical instruction were implemented by Gal'perin and his colleagues and followers in a number of experimental programs aimed at teaching children a variety of different subjects including mathematics, physics, language, and history [Aidarova, 1978/1982; Davydov, 1976/1988; El'konin & Davydov, 1966; Gal'perin, 1985; Obukhova, 1972; Salmina & Sokhina, 1975; Zhdan, 1968; and many others]. One of the most revealing in terms of its effect on cognitive development was the program designed for teaching the 5–6-year-old children elementary mathematics, specifically the formation of basic mathematical concepts [Gal'perin & Georgiev, 1960]. Although the fragments of this program are already described in English [see, e.g., Haenen, 1996; Karpov & Haywood, 1998], these descriptions are quite brief and do not focus on the impact of this program on the child's cognitive development. Below is a somewhat detailed analysis of this program which takes us directly to the implications for cognitive-developmental theory and research.

An example of a program for elementary mathematics instruction. Within Gal'perin and Georgiev's [1960] program, children were taught such fundamental concepts as the concept of number and the concept of a unit (i.e., 'one'), as well as other related concepts and arithmetic operations. Traditional instruction often fails to form genuine mathematical concepts in children. For example, the concept of a unit is often empirically introduced as merely some single separate object without any in-depth explanations. Children are taught that one (object) is one, not two or more, and that this is just something to accept, memorize, and follow. The 'theory' of the unit, that is, the way a unit (and any number) is 'produced' is not revealed to the child. This usually leads to the formation of empirical concepts in which the child erroneously identifies a unit with a discrete (separate) object [Gal'perin, 1981]. The concept of number in general is then also introduced on the basis of discreteness.

In contrast, within systemic-theoretical instruction, children mastered the method of scientific analysis which made it possible to form not empirical but theoretical mathematical concepts. This implied that children learned to distinguish and rationally analyze the properties of the object and to understand how certain properties and concepts were 'produced'. To be able to do this, children needed to be provided with relevant scientific tools found in the subject domain.

As many mathematical theories have it, all the basic types of numbers emerge as a result of measurement [e.g., see Lebesgue, 1958]. This view had been adopted in Gal'perin and Georgiev's [1960] program. Hence, first the idea of measurement was introduced to the children. Children were shown how important measurement is in various everyday situations, for example, in stores to establish the correct amount of goods. Then children learned to use measurement as an analytical tool to derive fundamental concepts in elementary mathematics.

More specifically, in the beginning, the children were taught the qualitative and quantitative aspects of measurement. The qualitative aspect of measurement is characterized by the fact that every property of an object can be measured only with an appropriate measure: one cannot measure the volume of water with a string of paper or measure weight with a spoon. Therefore, it is very important to know precisely what property of an object one wants to measure. While comparing different objects by length, size, volume, and weight under the guidance of a teacher and in discussion with peers, the children learned to discriminate between different properties of objects and to choose the appropriate measure for each property.

The quantitative aspect of measurement is characterized by the fact that the measure is not necessarily a separate object (thing): it may consist of several objects or be part of some object – this is a matter of choice and convenience. But once the measure is chosen, it is necessary to use the same measure until the measurement is complete. While performing different measurements, the children learned to stick to chosen measures.

In order to compare different objects by certain properties (length, weight, etc.), the children learned to properly measure and mark the results of each measurement with some material object (for example, a sheet of paper or button). The sets of markers now represented certain properties of the compared objects. Thus the children came to realize how the properties of things are transformed into multitudes which allow quantitative comparison. The objects were then viewed by the children as clusters of multitudes, each of which was *produced* by the measurement. Measurement at this stage mediated children's exploration and helped to reveal the qualitative and quantitative structure of objects. Then the children learned to compare objects by putting the elements of multitudes (markers) into one-to-one correspondence. Thus the concepts of 'larger', 'smaller', 'equal to', 'larger (smaller) by so much' became clear to the children.

It is only after this practical-exploratory work that the concept of a unit ('one') was introduced: a unit was explained as the equality of some property of an object (represented by certain multitude X) with a chosen measure M (one equals X divided by M when X equals M). Other numbers (up to ten) then could be constructed by the children themselves according to the rule ± 1 (less by 1 or greater by 1).

In sum, the fundamental concept of number was introduced to the children not empirically through separate objects but theoretically as a ratio of some quantity to a chosen measure (Number = X/M).

As already mentioned, the children came to master this method of analysis while actively exploring the properties of objects under the guidance of the teacher and with the help of cognitive tools (measures). The material markers could soon be replaced by more abstract symbols, and the material comparison of multitudes was replaced by operations with generalizing schemas.

The final stages of the program included other important elements. The children constructed numbers up to 100, and then up to 1000 in the same fashion, at the same time learning what each number is called and how it can be written. Then came the theoretical explanation of a 'zero' (not just as 'nothing' but as some point where the measurement starts), the children's mastery of the four arithmetic operations, of decimal fractions, and of the multiplication table (using the process of its construction, without intentional memorization).[4]

The general result of the program was the formation of genuine mathematical concepts in children a whole age period earlier – in 6-year-olds rather than in 10–12-year-olds, when it usually occurs [Piaget, 1946/1952]. Even more importantly, however, was that the children's entire view of things had changed: the children came to understand that things cannot be judged by their visual properties alone. As Piaget demonstrated [e.g., 1972/1974], the child of preschool age usually views one property of an object (for example, length) as a representative of a whole object: to change this one property means, for the child, to change the entire object and, consequently, all its properties. This characteristic of the preschooler's thinking underlies the child's spectacular display of nonconservation in Piagetian tasks.

In systemic-theoretical instruction, immediate judgment by visual characteristics was replaced by the analytical procedure in which children learned to discriminate among different properties of objects and transform a given property into multitudes by using certain measures. Consequently, the children got an insight into the *implicit structure of objects*, where each basic property of an object constitutes a separate multitude and an object itself (as a whole) was represented as a constellation of different multitudes. Thus, the children advanced from immediate (naïve-egocentric) thinking to thinking mediated by measure and measurement and thereby set themselves free from the domination of perceptual impression.

It came as no surprise then that in follow-up experiments, the children who were initially identified as consistent nonconservers in Piagetian tasks (they saw no problem in immediately concluding that the whole object changed, e.g., became 'smaller', when just one property of it, e.g., height, was transformed), after mastering the idea of measurement and the concept of number according to principles of systemic-theoretical instruction, refused to give an immediate answer to a conservation task. Instead, they would say: 'Let's first measure!' [Gal'perin, 1985]. As a result, the Piagetian phenomena of nonconservation completely disappeared in those children and the concept of conservation emerged, although this concept was not directly taught to the children.

In several studies, the developmental effect of instruction described above has been tested with Piagetian tasks for perception, memory, imagination, and speech. According to Piaget [1974], one can only speak about real development, not just improvement in domain-specific problem solving, if the change in children's cognition occurs simultaneously in different cognitive functions. This is exactly what has been found in the described studies: after the systemic-theoretical concept formation in elementary mathematics and physics, a similar radical change (from nonconservation to conservation)

[4] There are interesting parallels between Gal'perin and Georgiev's [1960] program and Stevenson and Stigler's [1992] observations of Japanese and Chinese elementary mathematics instruction. Similarities can be found between the two approaches in the emphasis on students' understanding the underlying relationships rather than just formal rules, in introduction of new concepts through posing real-world problems, in guiding students' coherent in-depth exploration of the problem rather than prompt switching from one problem to another, and in striving to stimulate students' thought and reflection rather than just a quick answer.

occurred in all the tested cognitive functions [Burmenskaya, 1976; Obukhova, 1972]. The method of systemic-theoretical instruction therefore 'brought the children, within a short time, to the end of that period of intellectual development that their peers in the control group had only just entered'. [Gal'perin, 1957/1989a, p. 37].

Some other demonstrative programs that built on the principles of systemic-theoretical instruction were aimed at teaching the grammar of the Russian language [e.g., Aidarova, 1978/1982; Karpova, 1967/1977]. The children in these programs mastered the linguistic analysis of words and phrases. The analysis occurred under the guidance of the teacher who provided the basic rules for children's linguistic exploration. Such analysis enabled the children to discover elementary 'message units', to relate them to the formal language structures, and to construct on this basis general models of words and sentences. After these models had been internalized, they became children's powerful tools of orientation in the speech activity and in the implicit rational structure of language. The result was similar to that obtained in systemic-theoretical instruction in elementary mathematics: Children widely transferred the acquired analytical method to different domains, specifically, from grammar to other aspects of Russian language, and then to other linguistic activities ranging from studying foreign languages to creating their own 'languages' according to a set of linguistic rules. In addition, the children acquired the fine 'sense of language' which allowed them to orient themselves in different shades of words' meaning and precisely select an appropriate word for a concrete case [El'konin, 1964/1974]. Hence, similar to the study on teaching elementary mathematics, this program resulted in spectacular cognitive-developmental change [Aidarova, 1978/1982, Zhdan, 1968].

Gal'perin's ideas of systemic-theoretical instruction had a direct impact on large-scale teaching experiments carried out by El'konin, Davydov, and their colleagues in the 60's, 70's, and 80's in a number of schools in Moscow, Volgograd, Kharkov, Tula, Ufa, and some other cities [for the discussion of this impact see Haenen, 1996]. Perhaps the most prominent instance was the study undertaken at Moscow school No. 91 and at Kharkov schools No. 4 and 17 [El'konin, 1976/1988; El'konin & Davydov, 1966]. New curricula were developed for studying mathematics, Russian language and literature, physics, biology, and fine arts. The major work was carried out at the elementary school level (grades 1–4). Some changes were also made to the curricula in mathematics, physics, and biology at the secondary school level (grades 4–8) [Davydov, 1986/1988].

The general outcomes of this long-term work were similar to those described above: most of the children advanced from the naive-empirical to the theoretical way of thinking in domain-specific problem solving with wide transfer to other domains and theoretical generalization [Davydov, Pushkin, & Pushkina, 1973; Maksimov, 1979]. Importantly, the systemic-theoretical teaching led to substantial progress not just in children's knowledge but also in their wider cognitive functioning. In particular, significant improvements occurred in children's abilities to analyze, plan, and reflect upon their actions, to set goals and systematically control their attainment [Zak, 1984], to perform different actions on the mental plane [Ponomarev, 1964], as well as in children's involuntary and voluntary memory [Repkina, 1983] and imagination [Poluyanov, 1982]. In addition, impressive changes occurred in children's learning motives: contrary to children in control classes whose motives for learning by and large remained pragmatically oriented (to get a good grade, to be more successful in learning than others), children in experimental classes gradually developed cognitive motivation in learning – a strong and stable interest in discovering hidden regularities in the material itself and general ways of problem solving [Dusavitskii & Repkin, 1975].

In the final part of this article, we discuss the relationship between cognitive development of the child and the types of instruction, to formulate some general conclusions.

Cognitive Development and Types of Instruction

From Gal'perin's analysis it follows that it is unproductive to discuss the role of instruction in the child's cognitive development without referring to the specific type of instruction that is actually applied in teaching children: depending on the type of instruction, its role may be substantially different.

Within the traditional type of instruction, the evidence of positive effects of learning on development remains ambiguous and disputable [cf., Cole, 1990].[5] Learning in traditional instruction occurs, as a rule, through gradual and mostly unsystematic (through trial-and-error) selection of successful versions of problem solving with little transfer or generalization of knowledge and with a heavy emphasis on rote memorizing. The results of learning then are largely a matter of individual effort and luck. All this indeed leaves researchers and educators with little choice other than to conclude that the role of instruction is very limited in cognitive development. However, this appears to be an overgeneralization based on the specifics of just one (traditional) type of instruction.

One common argument to corroborate the seemingly limited role of instruction in cognitive development is that basic characteristics of the child's cognitive development, as described by Piaget (e.g., the concrete and egocentric character of preschoolers' thinking) appear to be relatively stable across different cultural and instructional contexts [Piaget, 1955]. Many studies, though, cast doubts on this argument. For example, under certain experimental conditions, preschoolers' abilities to conserve and decenter – the abilities usually attributed only to school age children – prove to be in fact higher than previously suggested [e.g., Donaldson, 1978; Wohlwill & Lowe, 1962; and many others]. Other studies show that many features of young children's thinking may vary in different cultures [e.g., Cole, 1990]. However, the reasons for the relative stability and seemingly universal expression of Piagetian characteristics in the child's thinking (at least in industrialized countries) have not been analyzed in these studies.

As one can see from Gal'perin's analysis, the stability of Piagetian characteristics across various contexts can be explained by domination of the same, traditional type of instruction in most countries and schooling systems. The key features of this type of instruction – the incompleteness and empirical character of the learner's orientation in the task – are at the core of similarity in children's cognitive processes in seemingly diverse, but in fact, essentially common conditions and contexts.

In sum, the widespread domination of traditional instruction (with its limited developmental impact) leads many to believe that the developmental potential of instruction is limited in general. This overgeneralization is in fact due to lack of knowledge about other possible types of instruction. In addition, this lack creates an impression that cognitive development can be studied independently of learning, without integrating the particulars of instruction that the child is exposed to into the major develop-

[5] Recent studies do show that schooling positively correlates with cognitive performance, but what is behind this correlation – beyond the effects of staying at school – remains unclear [see, e.g., Ceci, 1991; Cole, 1990; Sternberg, 1997].

mental framework. Gal'perin's analysis suggests that this impression is quite misleading. We will come back to this point in the last section of this article in the discussion of the implications for developmental research.

As we described above, *in the second, systemic-empirical type of instruction*, the quality of knowledge and skills acquired by children was much higher in terms of stability, reflective reasoning, and accuracy of performance. All the children – regardless of inter-individual differences in their abilities – came to be able to master knowledge and cognitive skills within regular curricula [Gal'perin, 1974/1989b; Talyzina, 1975/1981; for an overview of scores of teaching programs see Haenen, 1996].[6] Many restrictions and rules of traditional instruction (e.g., emphasis on simple and graphic examples, the need to memorize basic principles, gradual progress from simple tasks to more complex ones) were no longer necessary. Given such a dependency of outcomes of learning upon the specifics of instruction, the suspicion arises that something is wrong with our understanding of many presumably intrinsic regularities and boundaries of development and learning – the understanding on which many of the rules of teaching themselves are based.

However, just like traditional instruction, systemic-empirical type of instruction provided no clear evidence of direct positive effect on the child's cognitive development. In other words, although the quality of concrete knowledge and cognitive skills was much higher in this instruction than in the traditional one, there was no apparent qualitative change in the child's overall thinking. The transfer (generalization) of acquired knowledge was limited to certain objects in a given domain. For example, this method was used to teach preschoolers to classify different objects. The children acquired this logical operation and performed the classification in the presented tasks with no errors at all. However, this cognitive skill remained isolated and did not affect the children's cognition outside the experimental situation – in their everyday activities they used this logical operation only when the adult asked them to do so. When they alone engaged in an activity that involved classification, they performed it on a typical (for preschoolers) pre-operational level [Gal'perin, 1985].

According to Gal'perin [1981, 1985], there are two reasons for the lack of general developmental impact in this type of instruction. The first reason is the empirical character of the orientation system (the system of indications and criteria necessary for action) provided to the child. The properties of objects or phenomena (e.g., in the criteria for classification or in concept formation) is represented empirically, that is, in their formal characteristics and without explanation of how those properties emerge. This makes it very difficult for the child to arrive at conceptually based generalization of most essential relationships between concrete objects and phenomena in the studied domain. Consequently, the child's way of thinking about things in that domain remains unchanged.

The second reason is that the orientation system (a set of didactic materials) in this type of instruction is presented to the child in a ready-made form, as a complete system of schemata, indications, clues, criteria, algorithms, and other cognitive tools necessary for competent problem solving. The children internalize these tools while applying them

[6] This does not mean, of course, that inter-individual differences in performance disappeared, but they now manifested themselves on a much higher general level of children's competence. Such results made Gal'perin conclude that in most cases poor outcomes of traditional instruction can be directly attributed to the specifics of instruction without reference to innate abilities [Gal'perin, 1989b].

and come to be able to solve the full range of tasks of that particular kind. However, this type of instruction directs children towards merely 'practical' use of knowledge as it is presented in the orienting system, rather than an analytical 'construction' of knowledge. This substantially reduces the developmental effects of learning within systemic-empirical instruction.[7]

Given the specific features of systemic-empirical instruction described above, one can understand why this type of instruction, carefully and extensively analyzed by Gal'perin and his followers [e.g., Talyzina, 1975/1981], is virtually ignored in reviews of their work published in English [e.g., Karpov & Haywood, 1998]. Most such reviews are concerned almost exclusively with educational implications of this branch of research and, therefore, focus on systemic-theoretical instruction. For practical education, systemic-theoretical instruction looks more beneficial than systemic-empirical instruction both in terms of quality of knowledge and the effects on cognitive development (see below).

However, when it comes to developmental theory, one should not underestimate the significance of the results yielded by systemic-empirical instruction. Generally, these results indicate that the traditional view of many 'intrinsic' regularities of cognitive development and specifics of child's mind needs to be revised. We will discuss this in the last section of this article, concerning the implications for developmental studies.

As described above, in the third, *systemic-theoretical type of instruction*, the character of knowledge itself (genuinely theoretical) and the way it is presented to the child (in conceptually based analysis) differed radically from the other types of instruction. The method provided the children with qualitatively new tools (means of mathematical, linguistic, or other kinds of analysis) to deal conceptually with a wide range of objects and phenomena extending far beyond the immediately studied area [Gal'perin, 1985]. As a result, the children's thinking progressed from the naïve-egocentric form to a scientific one, from the concrete-empirical to the conceptual-theoretical, and from the appearance-oriented to the essence-oriented way of thinking [Aidarova, 1978/1982; Burmenskaya, 1976; Davydov, 1986/1988; El'konin & Davydov, 1966; Gal'perin, 1985; Gal'perin & Georgiev, 1960; Obukhova, 1972; Salmina & Sokhina, 1975; Zhdan, 1968; for an overview see Haenen, 1996; Karpov & Haywood, 1998].

In summary, systemic-theoretical instruction arms students with a method of analysis based on discriminating basic units of material in the given domain and on general rules of combining those units in a concrete (empirical) phenomenon. This analysis – with the help of culturally evolved criteria and procedures (such as measurement) – allows students to understand and model the implicit rational structure of empirical objects and phenomena and their essential relationships within a studied discipline.

[7] As works by Gal'perin and his colleagues have demonstrated (e.g., Gal'perin, 1985; Obukhova, 1972), without active construction of knowledge (or, more precisely, conceptual reconstruction under the guidance of the teacher), it is very difficult for the child to reach a profound understanding of the basal structure and essential relationships in the studied discipline. Therefore, two aspects of learning – the character of the cognitive tools and the way those tools are presented to the student (either as a ready-made 'technological kit' or as a result of conceptual analysis in exploratory activity) – are equally important for developmental outcomes. These two aspects are inseparable in real learning. However, for the sake of analysis, we concentrate mostly on the first aspect – the character of cognitive tools provided to the child. Further elaboration of the second aspect – different ways of introduction of those tools – goes beyond the scope of this article. It is worth mentioning here, though, that the aspect of the child's guided exploratory activity in systemic-theoretical instruction links Gal'perin's research with studies where the child's exploration of the subject in socially shared activity is the main focus of investigation [e.g., Brown, 1997; Rogoff, 1994].

The models or schemas of the 'hidden' rational structure of objects and their essential relations, once they are internalized by children, become a key part of children's orientation in a broad subject domain. As new powerful cognitive tools, these models (operational schemas of thinking, in Gal'perin's terminology) qualitatively change the child's whole way of viewing things, thinking about things, and operating with things in a given domain. In fact, they advance the child's cognitive development to a new, unusually high level [Gal'perin, 1969/1989d].

Orientation in the implicit rational structure of empirical objects and their essential relationships (as revealed in the systemic-theoretical type of instruction) makes learning inherently meaningful and increasingly interesting to the child: such learning is based not on rote memorization and drill, but rather on the intriguing process of discovering rational and meaningful connections between seemingly unrelated objects, phenomena, and events, and on making sense of what on the surface looks completely formal and incoherent (e.g., in such a formal domain as grammar). In Gal'perin's studies, the children time and again turned to the acquired scientific analysis in various activities, far beyond and long after the experimental program. The newly formed modes of thinking became part of children's everyday cognition. This was further evidence of the substantial progress in children's cognitive development [Gal'perin, 1985].

From what was discussed above, can one conclude that some time in the future 'traditional' instruction can be totally replaced with systemic-theoretical instruction? In our view, the answer is 'no'. This will never be possible, for epistemological reasons, namely, due to the inevitable limits of domain-specific scientific knowledge. Systemic-theoretical instruction requires revealing the hidden rational structure of studied objects to students, which is predicated on the assumption that links, coherence, and regularities (in other words, some inherent logic) can be found in basically all subject domains, no matter how incoherent things look on the surface. The seeming incoherence means that we still do not know something substantial about a given domain. According to this view, in order to make learning rational and meaningful, the educator should reveal those hidden links and regularities to students in the course of instruction. However, such a requirement is not in all cases achievable.

As scientific knowledge in any subject domain is inherently limited, something substantial in the implicit structure of studied objects always remains unknown. This fundamental condition inevitably restricts the rational basis of instruction: We cannot rationally teach something that is not yet explained in science itself. Hence, one can only talk about a certain degree of rationality in instruction. As shown above, this degree can differ dramatically in different types of instruction, which has crucial implications for the developmental potential of instruction. A high degree of rationality combined with the method of guided exploration (as in systemic-theoretical instruction) makes instruction truly developmental. Nevertheless, traditional instruction – characterized by an incomplete orientation basis and empirical knowledge – despite its disputable developmental potential, cannot be completely discarded and will always remain 'historically' the first one. It is indispensable in those subject domains where scientific knowledge is not sufficient to teach otherwise. Hence, traditional instruction invariably precedes other types of instruction. This type of instruction is, therefore, 'natural' in a certain sense. However, it is important to emphasize that this instruction is natural *not* in the sense that it is based on some 'natural', intrinsic laws of cognitive development. To use Gal'perin's words, it is 'natural only in that same sense in which our unawareness *natu-*

rally precedes our knowledge' [Gal'perin, 1981, p. 430; italics in the original]. Wherever our knowledge allows, it is far more beneficial for children's cognitive development to introduce systemic-theoretical type of instruction.

Summary and Implications for Developmental Studies

Gal'perin's approach has a number of important implications for developmental theory and research, in particular, for the issue of the relationship between cognitive development and learning. Before we outline these implications, we need to summarize Gal'perin's findings and conclusions as follows.

As Gal'perin's studies indicate, cognitive development and instruction are inherently interrelated processes. This relationship, however, is not uniform and can only be adequately construed when the particular character of instruction is taken into account. In other words, cognitive development stands in different relation to particular types of instruction with different developmental potential.

The central property that defines the developmental potential of certain types of instruction (and, therefore, their specific role in development) is the quality of cognitive tools that are provided to the child in the course of instruction to help the child to be oriented in the task's conditions and to perform the task adequately. When the set of such tools is insufficient for successful performance and based on empirical concepts, the developmental potential of instruction is severely limited, and cognitive development is contingent rather on vicissitudes of the child's individual experience within and outside a given instructional context. In contrast, when the set of cognitive tools provided to the child is complete and based on theoretical concepts, instruction results in profound developmental progress. In this latter case instruction directly generates cognitive development.

Gal'perin singled out the basic features of the traditional type of instruction that still dominates most educational processes – foremost, its empirical character and the deficiency of children's orientation in the task. He analyzed the nature of implicit restrictions that this instruction imposes on cognitive development, and outlined the alternative developmental type of instruction. Consequently, the many features that are still (since Piaget's era) commonly viewed as inherent to young children's cognitive functioning (e.g., its prelogical, concrete, and superficial character) have been shown by Gal'perin to be directly generated by the specifics of traditional instruction, in particular, by deficient cognitive tools used by the child. Common views about the limitations of both the child's learning and the developmental potential prove to be untenable when alternative teaching-learning methods are introduced and the development of the child's mind is analyzed in the conceptual framework of such methods.

If the specific character of instruction (defined by the character of cognitive tools and procedures involved) is not taken into account while analyzing cognitive development, then the basic regularities of development itself evade clear interpretation. The observed picture of development can be quite misleading in this case: What is observed and portrayed as intrinsic developmental mechanisms, or age-related regularities (e.g., Piagetian characteristics of young children's thinking) may well be manifestations of cognitive development shaped by a particular, currently dominating type of teaching-learning.

Thus, Gal'perin's studies reveal that in many respects, our traditional understanding of the child's cognitive development reflects the implicit boundaries imposed on development by today's educational practices. The type of instruction on which most of those practices are based has a long history. It can be labeled 'traditional' but it still dominates modern education today.

Ironically, judged from the Gal'perinian perspective, the many requirements as to how to teach young children that are embedded in traditional instruction and usually thought to be grounded in some 'internal' properties of the child's mind, to a large extent generate such properties themselves. This often creates a self-perpetuating circle of 'inadequate theories of development – contingent educational practices – poor developmental outcomes – inadequate theories of development' which can be quite misleading for both education and developmental studies and theories. Gal'perin's work helps to break this vicious circle – by reconceptualizing the relationship between cognitive development and instruction in the context of new types of instruction with significantly higher developmental capacity.

Gal'perin's framework may potentially provide the key component for a new approach to development, envisioned by Vygotsky and currently pursued by many working in sociocultural tradition [for reviews, see Cole, 1996; Rogoff & Chavajay, 1995; Stetsenko & Arievitch, 1997]. Indeed, Gal'perin's perspective, through revealing the content of the processes that link learning and development, adds an important insight into what constitutes developmental change. This perspective can play a substantial role in operationalizing the mechanisms of qualitative change in the development of mind. Namely, the mechanisms that generate a shift to new forms of cognitive functioning can now be seen as embedded in what the child is doing while learning new, culturally evolved cognitive tools of a specific character, rather than in the internally driven regularities of development related to age or individual abilities.

Critically, it must be said that, although implicitly present, a broader, socio-interactional context of teaching-learning is obviously not in the focus of Gal'perin's account of the child's cognitive development through learning. This leaves aside essential aspects of cognitive development such as social meanings and goals, as well as the forms of children's participation in shared social and cognitive activities – aspects that are at the heart of many other sociocultural accounts of development and learning [e.g., see Rogoff & Chavajay, 1995]. Integration of these aspects into the Gal'perinian framework would advance the current understanding of cognitive development.

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